STUDENT GUIDE

TABLE OF CONTENTS:

1. TRUNKING INFORMATION

2. PRODUCT SERVICEBULLETINS

3. SIMPLIFIED DIAGRAMS
   &
   TROUBLESHOOTING INFORMATION

4. LAB WORKSHEETS

NATIONAL SERVICE TRAINING

Rockwell

10937 and 10957
ALPHANUMERIC DISPLAY CONTROLLER

DESCRIPTION

The 10937 and 10957 Alphanumeric Display Controllers, two of the Rockwell Intelligent Display Controller products, are MOS/LSI general purpose display controllers designed to interface to segmented displays (vacuum fluorescent, or LED).

The 10937 or 10957 will drive displays with up to 16 characters with 14 or 16 segments plus a decimal point and comma tail. Segment decoding within each device provides for the ASCII character set (upper case only). No external drive circuitry is required for displays that operate on 20 ma of drive current up to 50 volts. A 16 × 64-bit segment decoder provides internal ASCII character set decoding for the display.

The 10937 and 10957 are identical with the exception that the 10957 has two additional decodings for the decimal point and comma tail.

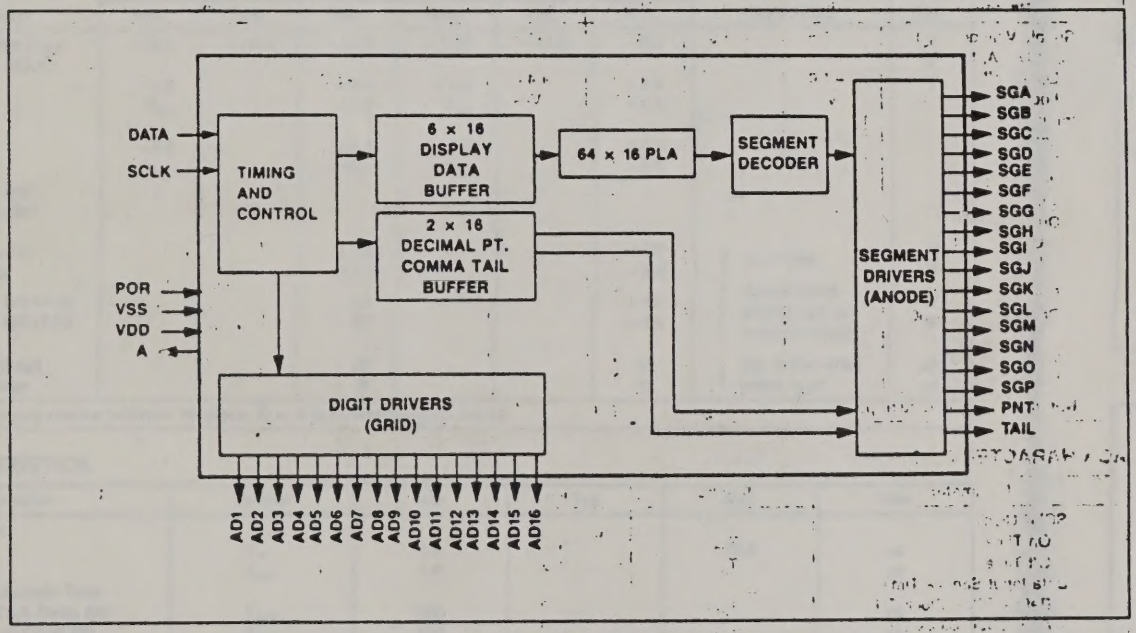
FEATURES

- 16 character display driver with decimal point and comma tail
- 14 or 16 drivers
- Up to 66 kHz data rate
- TTL compatible
- Direct digit drive of 20 ma at 50 volts
- Supports vacuum fluorescent, or LED displays
- 64 × 16-bit PLA provides segment decoding for ASCII character set (all caps only)
- Serial data input for 8-bit display and control words.
- 40-Pin DIP

ORDERING INFORMATION

Part Number	Package Type	Drive Voltage	Temperature Range (°C)
109X7P-40	Plastic	40V	0 to +70
109X7P-50	Plastic	50V	0 to +70
109X7PE-40	Plastic	40V	−40 to +85
109X7PE-50	Plastic	50V	−40 to +85

Note: X = 3 or 5

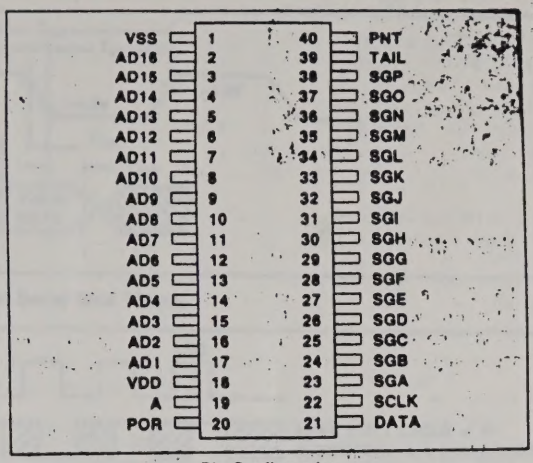


10937 and 10957 Block Diagram

INTERFACE DESCRIPTION

Pin Functions

Signal Name	Pin No.	Function
VSS	1	Power and signal reference
AD16–AD1	2–17	Digits 16 through 1 driver outputs
VDD	18	DC power connection
A	19	A clock output used for testing
POR	20	Power-on reset input
DATA	21	Serial data input
SCLK	22	Serial data clock input
SGA–SGP	23–38	Segments A through P driver outputs
TAIL	39	Comma tail driver output
PNT	40	Decimal point driver output



Pin Configuration

SPECIFICATIONS

MAXIMUM RATINGS*

All voltages are specified relative to V_{SS}.

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{DD}	+0.3	−20	V
Input Voltage	V_{IN}	+0.3	−20	V
Output Voltage	V_{OUT}	+0.3	−50	V
Operating Temperature				
Commercial	T_C	0	+70	°C
Industrial	T_I	−40	+85	°C
Storage Temperature	T_{STG}	−55	+125	°C
Input Capacitance	C_{IN}		5	pF
Output Capacitance	C_{OUT}		10	pF

*NOTE: Stresses above those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this document is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

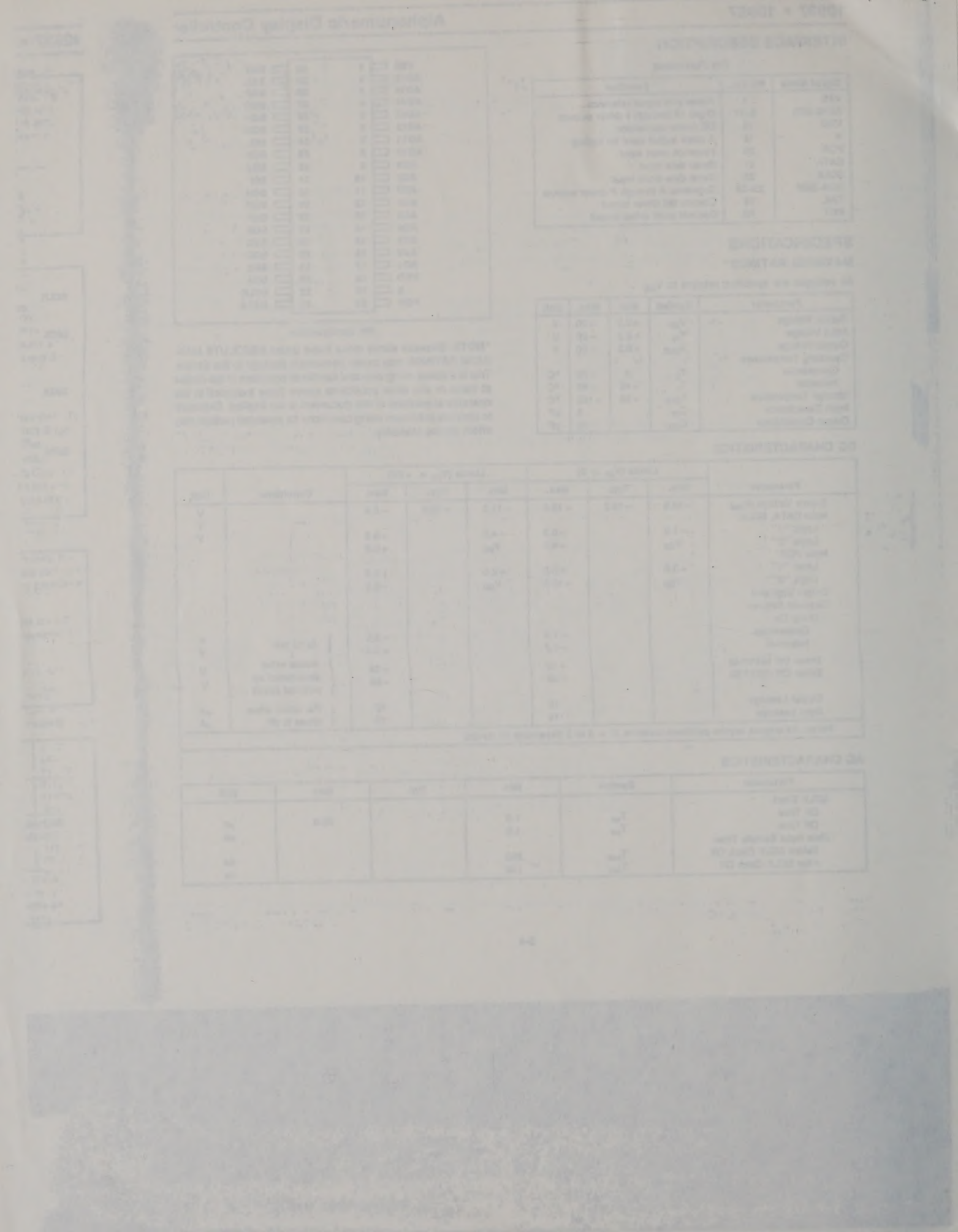
DC CHARACTERISTICS

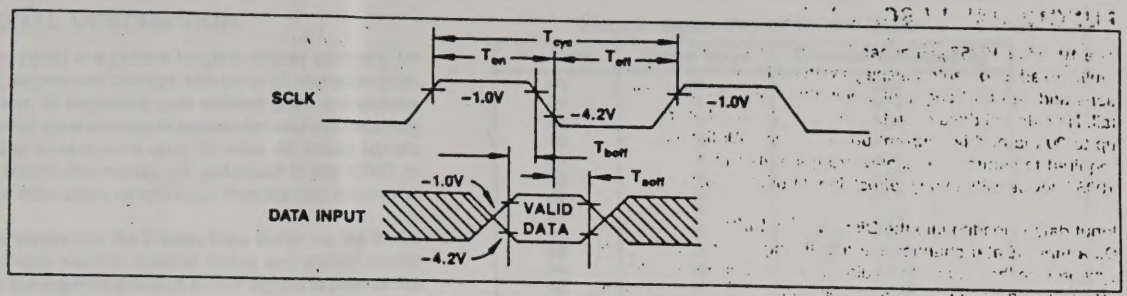
Parameter	Limits (V_{SS} = 0) Min.	Typ.	Max.	Limits (V_{SS} = +5V) Min.	Typ.	Max.	Conditions	Unit
Supply Voltage (V_{DD})	−16.5	−15.0	−13.5	−11.5	−10.0	−8.5		V
Input DATA, SCLK:								V
Logic "1"	−1.0		+0.3	+4.0		+5.3		V
Logic "0"	V_{DD}		−4.2	V_{DD}		+0.8		
Input POR								
Logic "1"	−3.0		+0.3	+2.0		+5.3		
Logic "0"	V_{DD}		−10.0	V_{DD}		−5.0		
Output Digit and Segment Strobes Driver On								
Commercial			−1.5			+3.5	At 10 mA	V
Industrial			−1.7			+3.3	At 10 mA	V
Driver Off 109X7-40			−40			−35	Actual value determined by external circuit	V
Driver Off 109X7-50			−50			−45	Actual value determined by external circuit	V
Output Leakage			10			10	Per driver when driver is off	µA
Input Leakage			10			10	Per driver when driver is off	µA

Notes: All outputs require pulldown resistors. X = 3 or 5 depending on device.

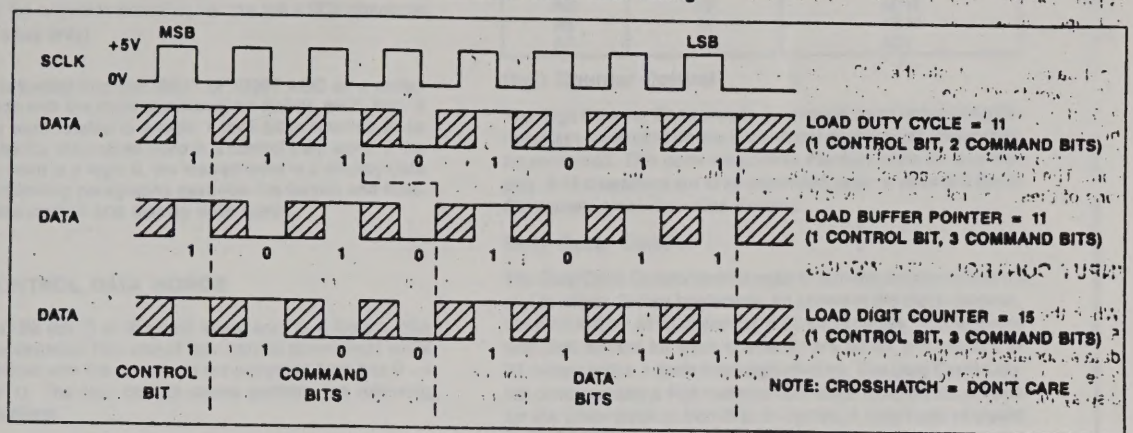
AC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
SCLK Clock					
On Time	T_{on}	1.0		20.0	µs
Off Time	T_{off}	1.0			µs
Data Input Sample Time					
Before SCLK Clock Off	T_{bsoff}	200			ns
After SCLK Clock Off	T_{asoff}	100			ns

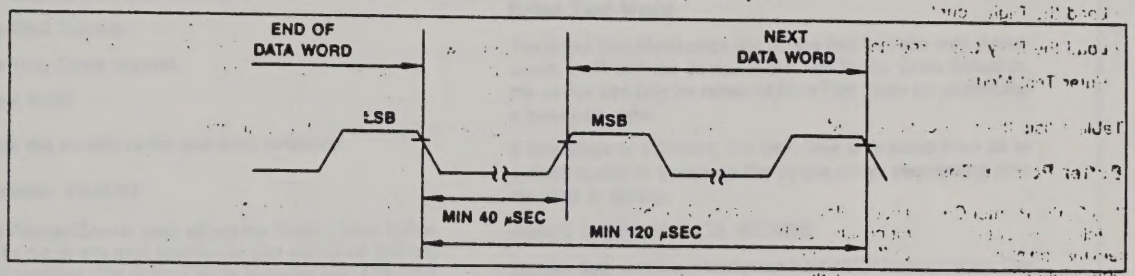




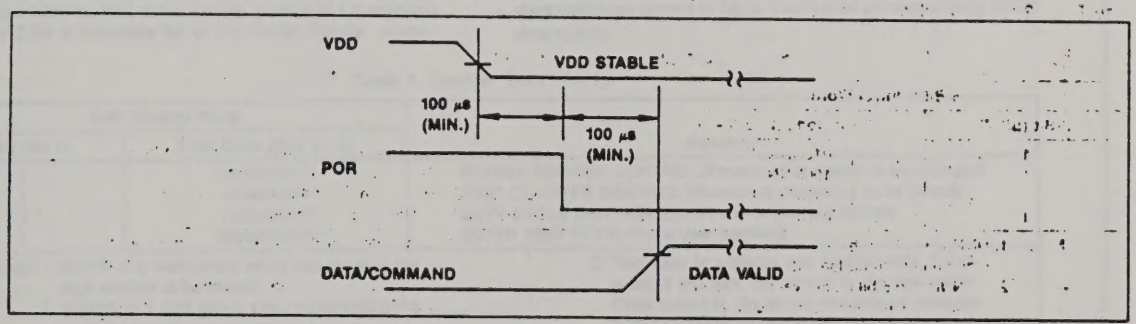
SLK and Serial Data Timing



SCLK and Serial Data (Control Word) Examples

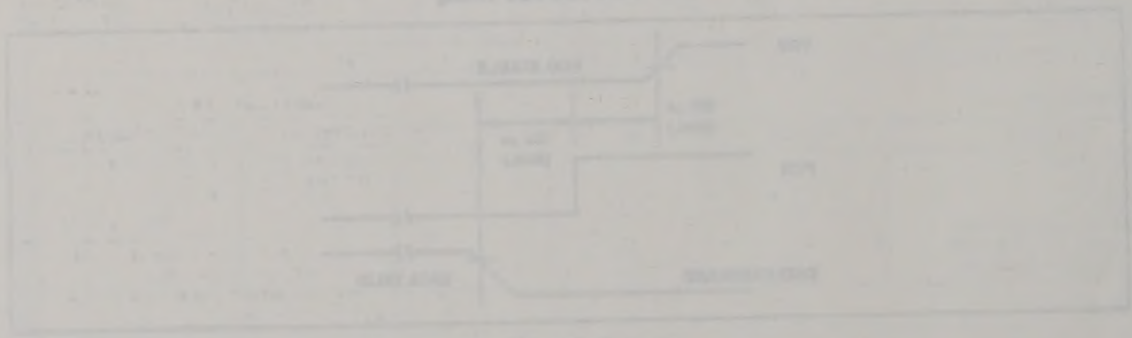


Data Word LSB/MSB Timing



Power-On Reset Timing

5



FUNCTIONAL DESCRIPTION

The 10937 or 10957 is a general purpose display controller for multiplexed, segmented displays with up to 16 character positions and 14 or 16 segments, plus decimal point and comma tail. No external drive circuitry is needed for displays requiring up to 20 ma of drive current up to 50 volts. All timing signals required to control the display are generated in the 10937 or 10957 device without any refresh input from the host processor.

Input data is loaded into the Display Data Buffer via the Serial Data Input (Data) channel. Internal timing and control blocks synchronize the segment and digit output signals to provide the proper timing for the multiplexing operation. A 16 x 64-bit PLA is provided for segment decoding for the full ASCII character set (upper case only).

Input data is loaded into the 10937 or 10957 ADC as a series of 8-bit words with the most significant bit (MSB), bit 7, first. If bit 7 of any word loaded is a logic 1 (this bit is referred to as the control bit C), the loaded word is a control data word. If the C bit of any word is a logic 0, the loaded word is a display data word. The following paragraphs describe the format and functions of these control and display data words.

INPUT CONTROL DATA WORDS

When the C-Bit (bit 7) of the 8-bit input word is a logic 1, bits 5 and 6 are decoded into one of four control commands while data associated with the command are extracted from bits 0 – 4 (see Table 1). The four control codes perform the following display functions:

- Load the Display Data Buffer pointer,
- Load the Digit Counter,
- Load the Duty Cycle register,
- Enter Test Mode.

Table 1 lists the control codes and their functions.

Buffer Pointer Control

The Buffer Pointer Control code allows the Display Data Buffer pointer to be set to any digit position so that individual characters may be modified. The Buffer Pointer is loaded with a decimal equivalent value 2 less than the desired value (i.e., to point to the digit controlled by AD6 of the display, a value of 4 is entered). See Table 2 for a complete list of the Buffer Pointer values.

Table 2. Buffer Pointer Control Codes

Hex Code	Pointer Value	Character Controlled By
A0	16	AD2
A1	1	AD3
A2	2	AD4
A3	3	AD5
A4	4	AD6
A5	5	AD7
A6	6	AD8
A7	7	AD9
A8	8	AD10
A9	9	AD11
AA	10	AD12
AB	11	AD13
AC	12	AD14
AD	13	AD15
AE	14	AD16
AF	15	AD1

Digit Counter Control

The Digit Counter Control code is normally used only during initialization routines to define the number of character positions to be controlled. This code maximizes the duty cycle for any display. If 16 characters are to be controlled, enter a value of 0 (zero). Otherwise, enter the value desired.

Duty Cycle Control

The Duty Cycle Control code is used to turn the display on and off, and to adjust display brightness. As shown in the block diagram, the time slot for each character is 32 clock cycles. The segment and digit drivers for each character are on for a maximum of 31 cycles with a 1 cycle inter-digit off-time. The Duty Cycle Control code contains a 5-bit numeric field which modifies the on-time for the driver outputs from 0 to 31 cycles. A duty cycle of 0 puts both the segment and digit drivers into the off state.

Enter Test Mode

The Enter Test Mode code is a device test function only. If executed, it will lock the device in the Test Mode. Once locked in, the device can only be removed from Test Mode by performing a power-on reset.

If this mode is activated, the digit time is reduced from 32 to 4 clock cycles to speed up the output driver sequencing time for ease in testing.

INPUT DISPLAY DATA WORDS

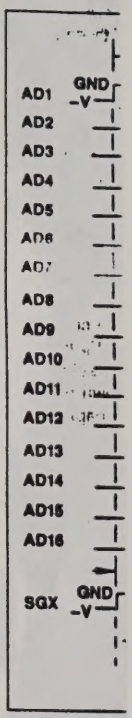
Display data words are loaded as 8-bit ASCII format codes. The 64 codes available (with the C-bit set to 0 to indicate a display data word) are shown in Table 3 with their corresponding ASCII characters.

Table 1. Control Data Words

8-Bit Control Word		Function
C-Bit (Bit 7)	7-Bit Code (Bits 6 – 0)	
1	010NNNN(1)	BUFFER POINTER CONTROL (Position of character to be changed)
1	100NNNN(1)	DIGIT COUNTER CONTROL (Number of characters to be output)
1	11NNNNN(2)	DUTY CYCLE CONTROL (On/off and brightness control)
1	00NNNNN(3)	ENTER TEST MODE (Not a user function)

Notes:
1. NNNN is a 4-bit binary value representing the digit number to be loaded.
2. NNNNN is a 5-bit binary value representing the number of clock cycles each digit is on.
3. This code is a device test function only. If executed it will lock the device in the test mode. Once locked in, the device can only be removed from Test Mode by performing a power-on reset.

Sixteen displa
the Display Da
mented befor
except for dec
the Buffer Poi
with the previc



DATA WORI	
BINARY	H
0X000000	
0X000001	
0X000010	
0X000011	
0X000100	
0X000101	
0X000110	
0X000111	
0X001000	
0X001001	
0X001010	
0X001011	
0X001100	
0X001101	
0X001110	
0X001111	

Note: X means

Sixteen display data words must be entered to completely load the Display Data Buffer. The Buffer Pointer is automatically incremented before each data word is stored in the Display Buffer except for decimal point and comma words. These do not cause the Buffer Pointer to increment and thus are always associated with the previous character entered. To select the next character position to be loaded out of the normal sequence, use the Buffer Pointer Control command before entering the display data word. It is not necessary to use the Buffer Pointer Control command to cycle back to position 1 when less than 16 character positions are being used.

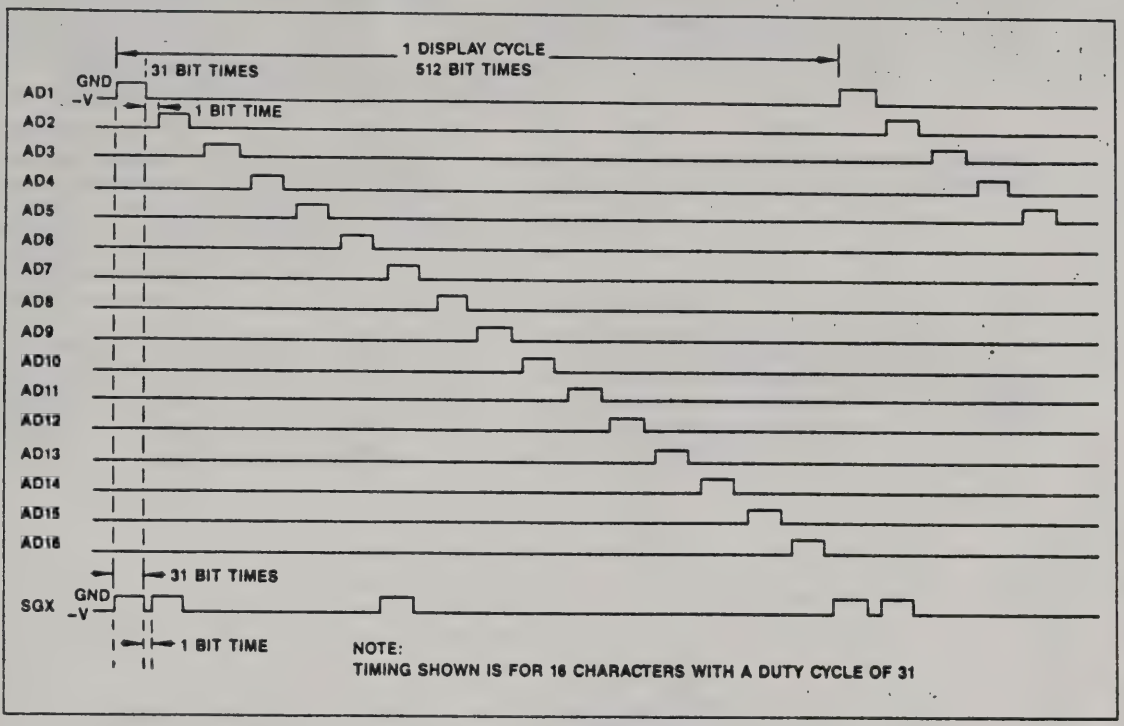


Figure 1. Display Scan Timing Diagram (Duty Cycle)

Table 3. Character Assignments for Display Data Words

DATA WORD BINARY	DATA WORD HEX	CHARACTER	DATA WORD BINARY	DATA WORD HEX	CHARACTER	DATA WORD BINARY	DATA WORD HEX	CHARACTER	DATA WORD BINARY	DATA WORD HEX	CHARACTER
0X000000	00	@	0X010000	10	P	0X100000	20		0X110000	30	0
0X000001	01	A	0X010001	11	Q	0X100001	21	!	0X110001	31	1
0X000010	02	B	0X010010	12	R	0X010010	22	"	0X110010	32	2
0X000011	03	C	0X010011	13	S	0X100011	23	#	0X110011	33	3
0X000100	04	D	0X010100	14	T	0X100100	24	$	0X110100	34	4
0X000101	05	E	0X010101	15	U	0X100101	25	%	0X110101	35	5
0X000110	06	F	0X010110	16	V	0X100110	26	&	0X110110	36	6
0X000111	07	G	0X010111	17	W	0X100111	27	'	0X110111	37	7
0X001000	08	H	0X011000	18	X	0X101000	28	(	0X111000	38	8
0X001001	09	I	0X011001	19	Y	0X101001	29	)	0X111001	39	9
0X001010	0A	J	0X011010	1A	Z	0X101010	2A	*	0X111010	3A	:
0X001011	0B	K	0X011011	1B	[	0X101011	2B	+	0X111011	3B	;
0X001100	0C	L	0X011100	1C	/	0X101100	2C	,	0X111100	3C	<
0X001101	0D	M	0X011101	1D	]	0X101101	2D	—	0X111101	3D	=
0X001110	0E	N	0X011110	1E	^	0X101110	2E	.	0X111110	3E	>
0X001111	0F	O	0X011111	1F	-	0X101111	2F	\	0X111111	3F	?

Note: X means this bit (bit 7) is a "don't care" bit except for PNT and TAIL on 10957 only. The hex codes shown assume bit 7 is a zero.

5

POWER-ON RESET (POR)

The Power-On Reset (POR) initializes the internal circuits of the 10937 or 10957 ADC when power (V_{DD} is applied. The following conditions are established after a Power-On Reset:

a. The Digit Drivers (AD1 – AD16) are in the off state (floating).
b. The Segment Drivers (SGA – SGP) are in the off state (floating). This includes PNT and Tail.
c. The Duty Cycle is set to 0.
d. The Digit Counter is set to 16 (a bit code value of 0).
e. The Buffer Pointer points to the character controlled by AD1.

DIGIT DRIVERS (AD1–AD16)

The sixteen Digit Drivers (AD1 – AD16) are used to select each of the display digits sequentially during a refresh scan. Display segments will be illuminated when both the Digit Drivers and Segment Drivers for a particular character are energized simultaneously. The timing characteristics of both the digits and segments are shown in Figure 1. See POR for the Power-On Reset state of these drivers.

Table 4. Additional Codes for PNT and Tail On 10957

DATA WORD		CHARACTER
BINARY	HEX	
01101100	6C	. (Tail only)
01101110	6E	Blank

SEGMENT DRIVERS (SGA–SGP)

Sixteen (16) Segment Drivers are provided (SGA – SGP), plus the decimal point (PNT) and comma tail (TAIL). The segment outputs are internally decoded from the 8-bit characters in the Display Data Buffer by means of a 64 × 16-bit PLA. The Segment Driver Allocations are shown in Figure 2. Data codes and their corresponding segment patterns are shown in Figure 3. Timing characteristics for the segment outputs are shown in Figure 1. See POR for the Power-On Reset state of these drivers.

NOTE

For 14-segment displays, SGA is used for the top segment and SGF is used for the bottom segment. SGB and SGE can be floated.

TYPICAL SYSTEM HOOK-UP

Figure 4 shows the 10937 or 10957 as it would be connected to a V-F display when driven by a host system. E_K is determined by the V-F display specifications and R_C is selected to provide proper biasing current for zeners. Pull down resistors R_A and R_G are determined by the interconnection capacitance between the device and the display.

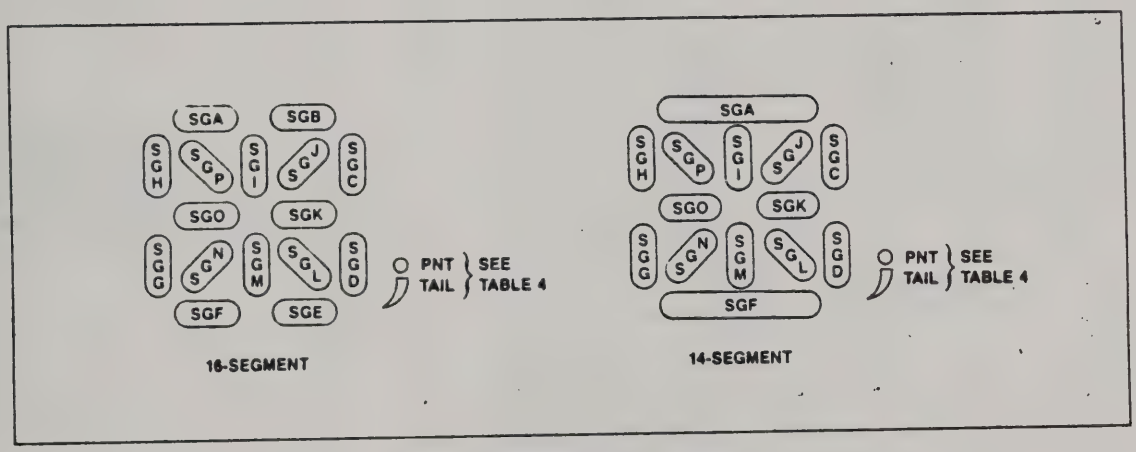
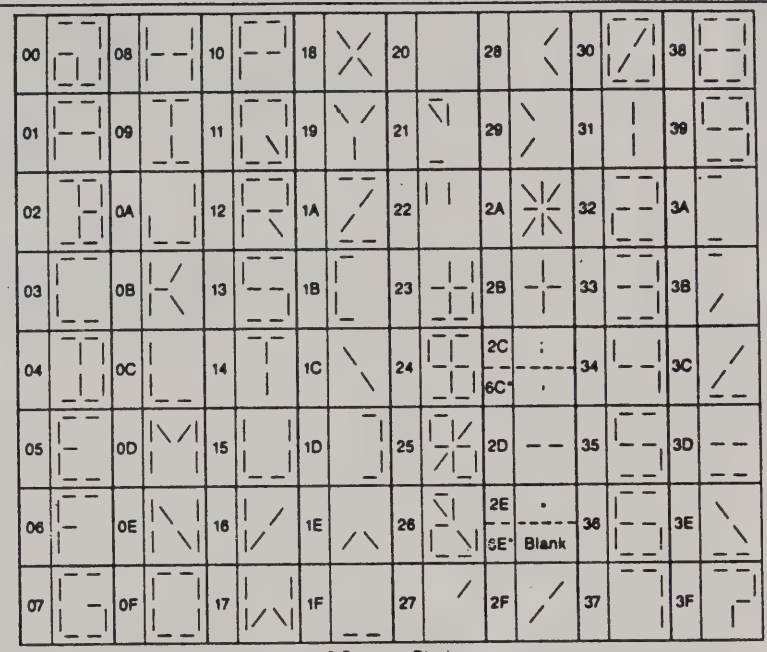
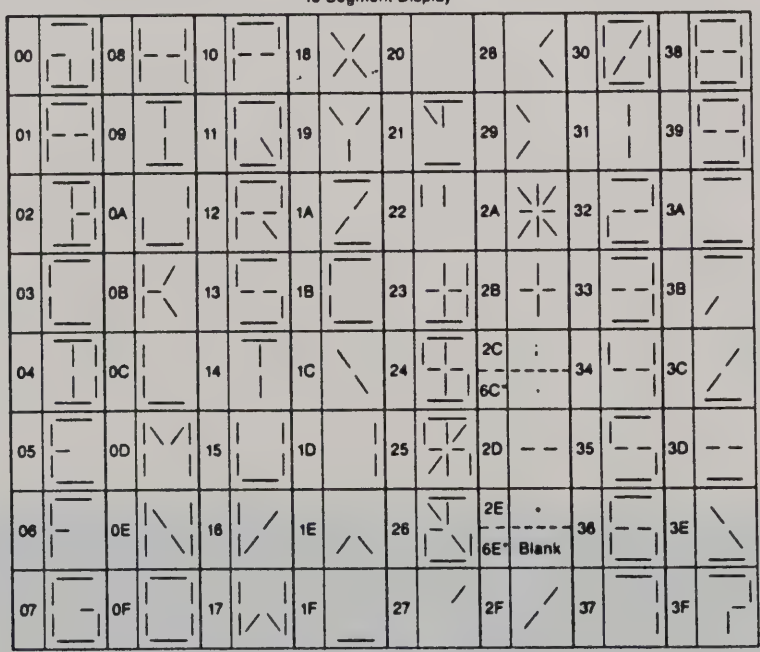


Figure 2. Segment Driver Allocations



16-Segment Display



14-Segment Display

Notes: Bit 7 of the data byte is a "don't care" bit except for PNT and TAIL on 10957. Data byte hex codes shown assume bit 7 is a zero.
* = 10957 only.

Figure 3. Display Segment Driver Character Patterns

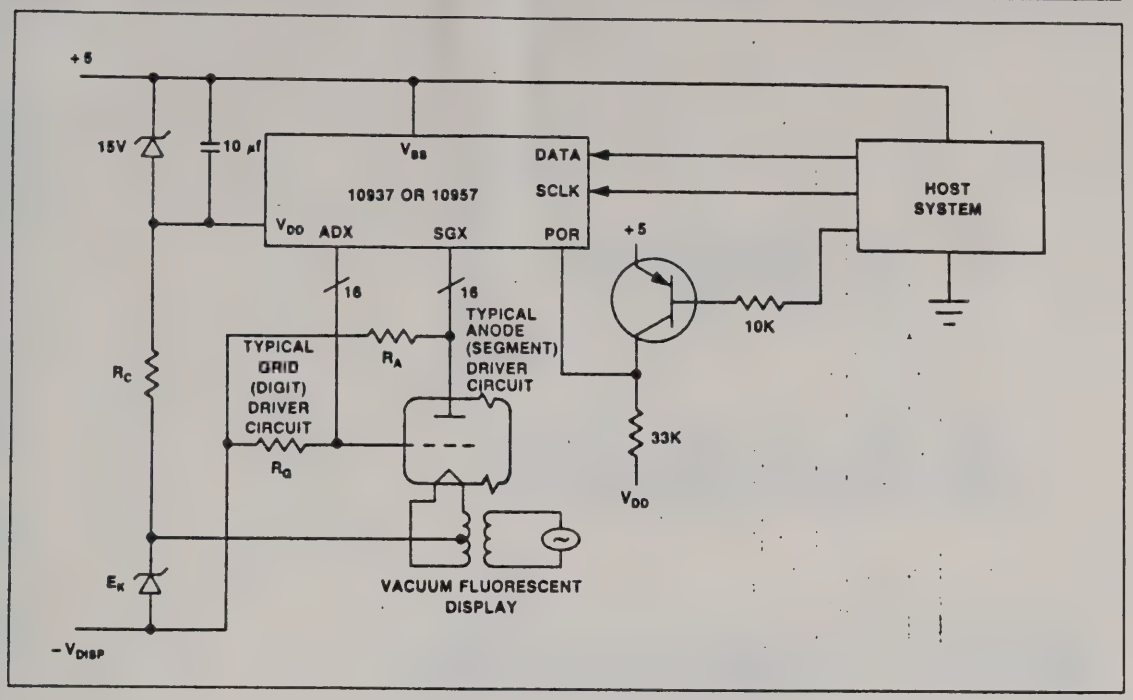


Figure 4. Partial System Schematic

DESCRIPTION

The Rockwell 10938
is a two-chip MOS/LS
designed to interface
or LED).

The two chip set will
and up to 20 grids (c
cascaded to drive lar
An internal PLA type
dot pattern generatio
an additional 32 spe

ORDERING INF

Part Number
10938P
10938PE
10939P
10939PE

10938

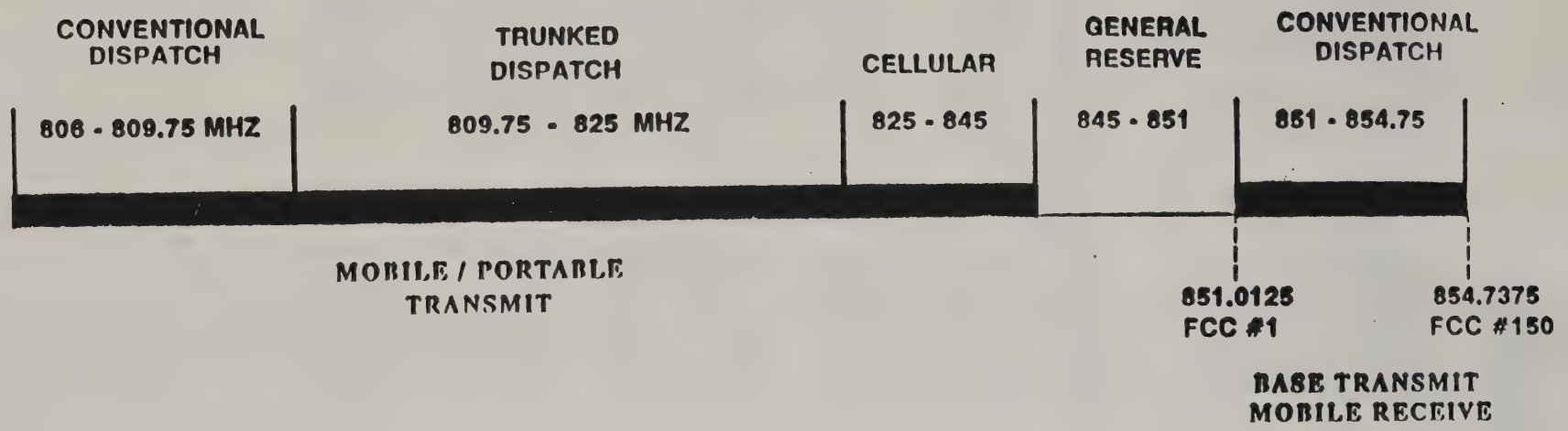
Document No. 290

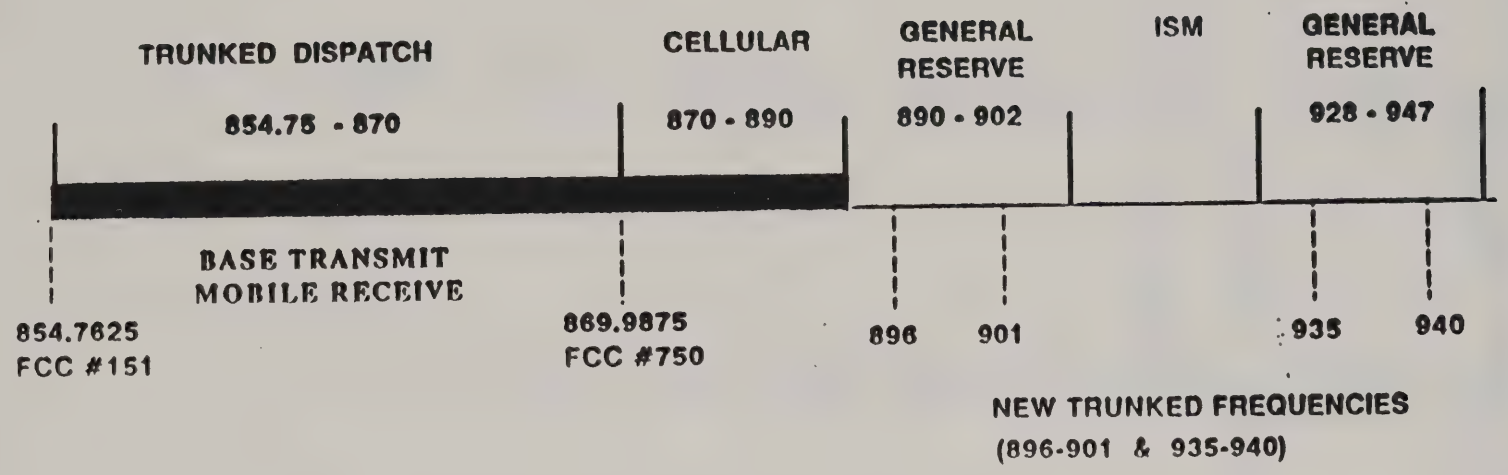
TYPE I

TRUNKING

INFORMATION

800 MHZ BAND ALLOCATIONS





FCC 800MHz ALLOCATIONS

Conventional Frequencies

FCC Channel No.	Motorola Channel No.	Mobile Rx Frequency(MHz)	Mobile Tx Frequency(MHz)
1	0	851.0125	806.0125
2	1	851.0375	806.0375
148	147	854.6875	809.6875
149	148	854.7125	809.7125
150	149	854.7375	809.7375

Trunked Frequencies

FCC Channel No.	Motorola Channel No.	Mobile Rx Frequency(MHz)	Mobile Tx Frequency(MHz)
151	150	854.7625	809.7625
152	151	854.7875	809.7825
153	152	854.8125	809.8125
274	273	857.8375	812.8375
275	274	857.8625	812.8625
276	275	857.8875	812.8875
421	420	861.5125	816.5125
422	421	861.5375	816.5375
423	422	861.5625	816.5625
500	499	863.4875	818.4875
501	500	863.5125	818.5125
502	501	863.5375	818.5375
581	580	865.4625	820.4625
582	581	865.4875	820.4875
583	582	865.5125	820.5125
584	583	865.5375	820.5375
757	756	869.9125	824.9125
758	757	869.9375	824.9375
759	758	869.9625	824.9625
760	759	869.9875	824.9875

NEW FLEET MAP CHOICES
ID'S, SUBFLEETS PER FLEET

Eight weighted points permitted per system

Size Code (Prefix)	Weighted Points	Fleets	Subfleets per Fleet	Max Unit IDs per Fleet
A prime	1	128	3	16
B prime	1	16	7	64
C prime	1	8	7	128
D prime	1	1	15	512
E	1	64	3	32
F	1	32	7	32
G	1	32	3	64
H	1	16	3	128
I	1	8	3	256
J	1	4	7	256
K	1	2	15	256
M	2	1	15	1024
O	4	1	15	2048
Q	8	1	15	4096

A through D prime are existing fleet types that are standard.

TRUNKING INTRODUCTION

I. **Trunking Definition**

A. **An FCC classification of Specialized Mobile Radio Service (SMRs).**

B. **Old telephone company term/technique: "Automatic sharing of a small number of communications paths among a large number of users."**

II. **Frequency Assignments**

A. **Channels are normally issued in blocks of 5**

1. Standard channel spacing is 25KHz

2. Maximum Deviation + Voice + Data = 5KHz

3. Trunked channels:

a. start: FCC channel #1
b. end : FCC channel #150

B. **Each repeater in the block is 1MHz apart from the other.**

III. **Loading Criteria**

A. **FCC considers 100 subscribers (users) per channel as standard.**

1. Loading:

a. 5 channel system = 500 subscribers
b. 20 channel system = 2,000 subscribers

B. **Channels can also be added individually.**

BASIC SYSTEM COMPONENTS

IV. Subscriber Units

A. Mobiles, portables, control stations

B. Simplified Operation

1. Elimination of squelch control and the need for channel monitoring before transmitting.

2. If the system is busy, the mobile will produce a busy tone.

3. When a channel is available, the mobile will produce a talk permit tone.

C. Mobile Code Plug Contents:

1. System ID
2. Fleet ID
3. Individual ID
4. Subfleet ID
5. Channel pairing table
6. Failsoft channel
7. Talk permit tone flag
8. Time-out timer

D. Trunking Logic Circuitry

1. (System) Control Channel:

   a. used to transfer digital data

   b. links subscriber units to the Central Controller

2. Subscriber Unit Logic Circuitry Functions:

   a. Scans and remembers the Control Channel ID

   b. Mobile Microphone PTT pressed:

      (1) Encodes and transmits inbound service requests to the System Central Controller.

      (2) Automatically tunes to receive mode to decode and respond to outbound commands sent by the System Central Controller.

      (3) Automatically tunes to assigned Voice channel.

(4) Generates sub-audible Connect Tone to maintain the system connection.

(5) Controls the radio time-out timer (TOT).

c. On command from the Central Controller, the subscriber will:

(1) Generate and sound Alert Tones.

(2) Enables and disables the transmitter.

(3) Mutes and unmutes the transmitter's microphone audio.

(4) Mutes and unmutes the receive audio.

V. Base Station Repeaters

A. 800/900MHz "Trunked" Base Station Repeater

B. RF Power: 35, 70, 125Watts at continuous duty ratings.

C. Base Station Assignments:

1. Control Channel: one of the four highest frequencies used to transmit and receive data.

a. Central Controller: transfer voice channel assignment data or other commands to the user.

b. Base Station with the lest amount of key up is chosen as the next System Control channel and is always keyed while assigned.

c. All data words are approximately 23mS long.

(1) can address a particular user and specify action to be taken.

(2) assembled into a coded format which has error correction and detection.

(3) 3600 baud

2. Voice Channel: transfers normal voice signals.

a. selection process: step down to next available frequency.

b. Only keyed up when needed.

c. Continuous sub-audible tones accompany all user originated transmissions.

d. Base to mobile transmissions contain a sub-audible digital signal.

VI. System Central Controlled

A. Control Tasks:

1. Monitor and control each call sequence/

a. Has call been received?

b. Is a voice channel available?

c. Has the originating user acknowledge the voice channel assignment?

2. Monitors voice channel activity

3. Selects and assigns the available voice channels as required.

4. Controls the Base Station Repeaters.

a. unkeys during slack periods.

b. rotates the control channel frequency daily (equalize equipment aging).

B. Receiver Tasks:

1. Recover and decode inbound signalling requests.

2. Monitor and report alarm conditions.

C. Transmit Tasks:

1. Generates sub-audible data:

a. superimposed on voice communication.

b. used to unmute authorized user receive audio circuits.

2. Generates Base Station ID.

3. Monitor and report alarm conditions.

D. **Programming: limited required, performed at the factory.**

1. Required Customer supplied information:

   a. RF Channel Identifiers (each channel frequency ID)

   b. Base Station ID (BSI).

      (1) transmitted in morse code once every 30 min (FCC regulation)

      (2) 17wpm, 900Hz tone modulation

   c. B.S.I. Channel

   d. System Control Channels (usually four highest frequencies.)

   e. Autotest (change control channel and does diagnostic tests.)

   f. Type of Trunking

      (1) Transmission trunking: no hang time

      (2) Message trunking: programmable hang time

VII. Types of Trunking

A. Transmission trunking (System/Fleet wide calls)

1. Must be initiated through the control channel and **will not be processed** until all members of the group have returned to the control channel.

2. Central Controller:

   a. Detects the disconnect signal from the user: immediately disconnects the voice channel.

      (1) user: mute and tune to the control channel

      (2) no hang time

3. User wants to respond to the original call: Entire assignment procedure repeats. (Usually assigns a different voice channel.)

4. Advantages:

   a. User's Individual ID always known by the Central Controller and Data Logger.

   b. Capability to inhibit new call requests within the group.

5. Disadvantage:

   a. Prior to new voice communication all users must return to the control channel for voice channel assignment. May not maintain same voice channel as the originating user.

      (1) increases of chance of mid-conversation busy.

B. **Message Trunking (Subfleet calls)**

1. 0 - 6 second time out (hang time)

   a. If **does not** time out:

      (1) User of the same group can respond using the same voice channel. Does not tune to the control channel for a new voice channel assignment.

   b. If **does** time out:

      (1) Central Controller:

         (a) transmits Low Speed Disconnect Word and the voice channel.

            i) disconnects users int the group

            ii) 300 baud, low deviation, 125mS

      (2) Users:

         (a) detects Low Speed Disconnect Word

            i) mute and tune to the control channel.
            (The voice channel is now available for reassignment by the Central Controller.)

2. Advantage: No mid-conversation busies.

3. Disadvantage: Responding users' ID is unknown.

VIII. System Wide Call (Optional): Transmission Trunked

A. Operation:

1. Dispatcher requests a system wide call.

   a. Any active message trunked calls in progress become a transmission trunked call.

   b. Receives busy signal until all users involved with message trunked calls tune to the control channel.

   c. All **fleets** are assigned to one voice channel.

   d. The call ends when the dispatcher unkeys.

Notes:

1. **Emergency, Private Conversation (PC), and telephone interconnect calls are <u>not</u> affected by system wide calls.**

2. Message trunked calls in a busy queue are dropped.

IX. Fleet Wide Call (Optional): Transmission Trunked

A. Operation:

1. Fleet Manager requests a fleet wide call. (Call set-up is the same as a system wide call.)

Notes:

1. **Emergency, Private Conversation (PC), and telephone interconnect calls are <u>not</u> affected by system wide calls.**

2. Message trunked calls in a busy queue are dropped.

X. Subfleet Call: Message Trunked

A. Characteristics:

1. Subfleet is a division of a fleet.

2. User can communicate with other users of the same subfleet.

B. Multiple Fleet/Subfleet Select (Optional)

1. Selector switches: users assigned to multiple fleet/subfleets, can communicate in any assigned fleet/subfleet.

2. Dispatcher and select users can be programmed for this option.

C. Private Conversation (Optional): private conversation between two members of a subfleet.

D. Call Alert (Optional): allows a dispatcher to selectively page an individual user.

E. Telephone Interconnect (Optional): trunked system is able to access public service telephone facilities.

SYSTEM ACCESS FEATURES

XI. Talk Prohibit Tones

A. Busy

B. Out of Range/Out of Service

XII. Talk Permit

A. All channels busy:

1. User placed in a waiting queue

   a. First In First Out (FIFO)

   b. Voice channel becomes available:

      (1) Central Controller calls the user back using a short series of three beeps.

XIII. Automatic Retry

A. Description: User units are designed to continually send channel request until the Central Controller acknowledges the request <u>or</u> until 4 seconds (16 attempts) have elapsed.

1. Initial request may not be received by the Central Controller because the user is out of range <u>or</u> the transmission is too noise.

2. Automatic retries are random. (Eliminates contention of control channel.)

B. The operator does <u>not</u> have to continually key.

XIV. Fleet Mapping

A. Definition: software "code" (ID) is stored in the Central Controller's non-volatile memory.

1. Determines how the Central Controller interprets the request for service (Inbound Signaling Word (ISW)) from the user.

2. The same "code" (ID) is stored in the user's code plug.

   a. Able to decode channel grant (Outbound Signalling Word (OSW)) from the Central Controller.

B. Fleets

1. Definition: roster of IDs indicating each user.

2. Multiple fleet capability

   a. Each fleet is a different roster of IDs.

   b. One user can have a different ID for each fleet (roster).

3. (Personality)Trunking ID = Fleet ID + Individual ID

   a. If a user requests calls for different subfleets of the same fleet, the (Personality) Trunking ID <u>does not change</u>.

C. Multiple Priority Levels: Immediate access may be necessary during busy periods.

1. Emergency call (Smartnet only)

2. Tactical

3. Command

4. Operational

5. Normal

D. Call Priorities: Priorities level ordering process.

1. Emergency call: processed first down to normal calls which are processed as voice channels are available.

2. Dispatcher/Supervisor: ability to assign priority levels other than normal.

    a. Not controlled by the user.

    b. Entered by the System Manager's Terminal using the Subscriber Access Control (SAC)

E. Recent User Priority

1. Previous voice channel assignment has timed out.

    a. Will have priority over new users: maximum 10 seconds after time out.

SYSTEM RELIABILITY FEATURES

XV. Multiple Channels

A. Channels are assigned as needed. The user is not dependent on any given channel.

B. The failure of a channel is <u>not</u> apparent to the user.

XVI. Back up Control Channels

A. Central Controller is programmed to assign another repeater as the control channel.

1. Any four frequencies (usually the highest four) can be assigned.

   a. Control channel is rotated daily between these four channels.

XVII. Receiver Interference:

A. Unauthorized signal received by repeater which gives the Central Controller a receive indication.

1. Central Controller will shut down the repeater giving the erroneous indication for a specific period of time.

XVIII. Base Station Transmitter Power Failure Shutdown

A. Power Out decreases or fails:

1. Central Controller: detects and removes the base station from service.

XIX. Misdirected Radio Protection

A. Description: user from a different fleet/subfleet assigned same voice channel.

1. Misdirected user:

   a. will not accept the outbound data

   b. Tunes to control channel.

XX. Continuous Assignment Updating

A. **Description: Central Controller will transmit channel assignment, on the control channel, as long as the voice channel is assigned.**

1. User coming into service (also assigned to a group which has a call in progress):

a. Detects channel assignment on the control channel and tunes to assigned voice channel.

XXI. System Self Diagnostics

XXII. Failsoft

A. **Description: Central Controller inoperative, all users tune to pre-programmed failsoft frequency.**

1. All users will operate in conventional mode only, (Fleet/subfleet privacy lost.)

2. Sub-audible data handshake activated on each channel.

a. Consequently, a **user out of range does not mistakenly go into failsoft.**

3. User failsoft indication: audible alert tone every 10 seconds.

4. Failsoft channel assignments are a function of the user code plug programming.

SYSTEM TIME - OUTS

XXIII. Carrier

XXIV. Fade

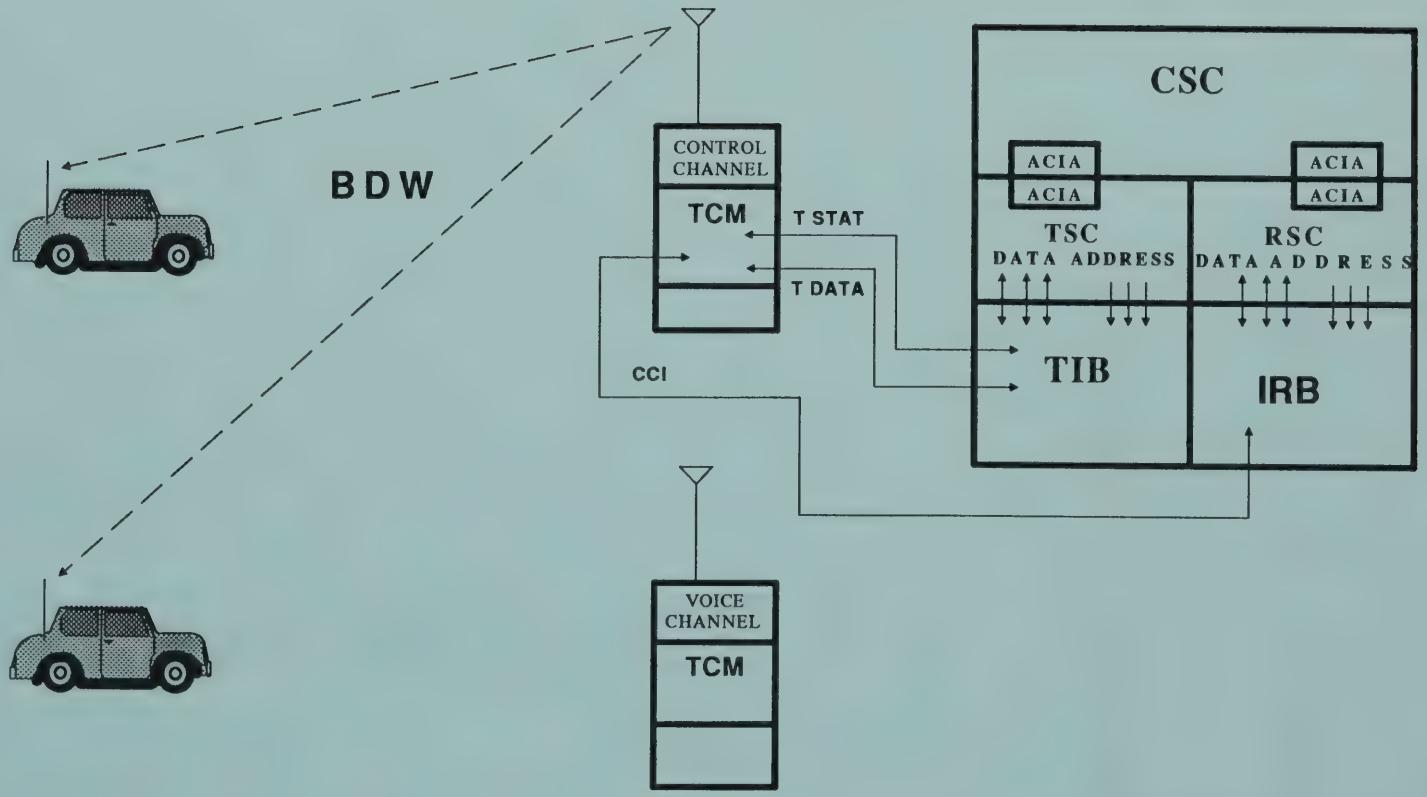
XXV. Message Trunk

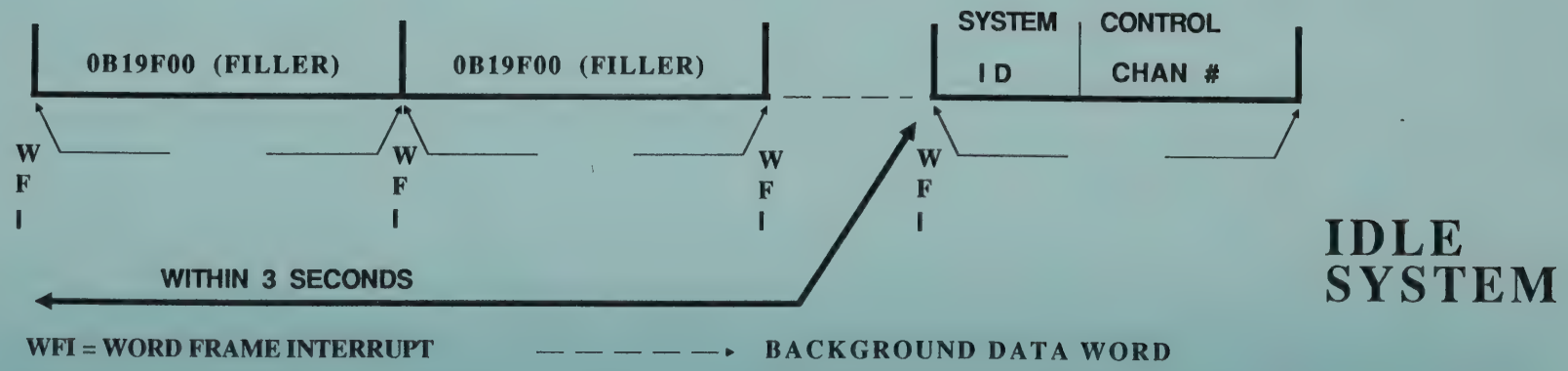
XXVI. Carrier Malfunction

May be edited by the System Manager"s Terminal using the Parameters (PARM) command.

Type II

Signalling Sequence


BDW
CONTROL CHANNEL
TCM
T STAT
T DATA
CCI
CSC
ACIA
ACIA
ACIA
ACIA
TSC
DATA ADDRESS
RSC
DATA ADDRESS
TIB
IRB
VOICE CHANNEL
TCM


0B19F00 (FILLER)
0B19F00 (FILLER)
SYSTEM ID
CONTROL CHAN #
WFI
WFI
WFI
WFI
WITHIN 3 SECONDS
WFI = WORD FRAME INTERRUPT
BACKGROUND DATA WORD

IDLE SYSTEM

Call Sequence Signalling

Idle System

A. Scans for control channel

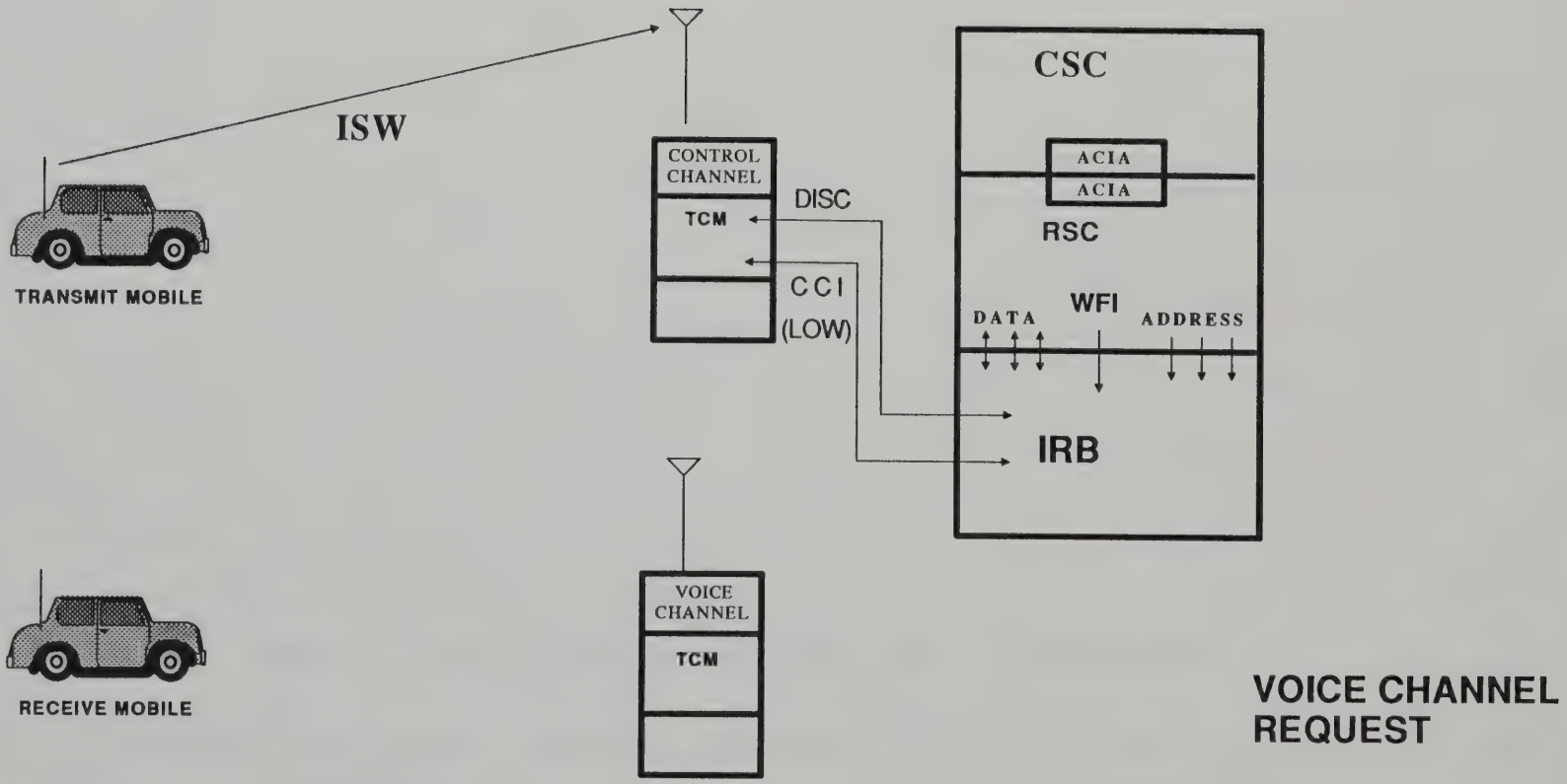
B. When System ID is found, the unit will monitor background data word, (used for bit and word synchronization).

C. Once locked on control channel, mobile watches and decodes.

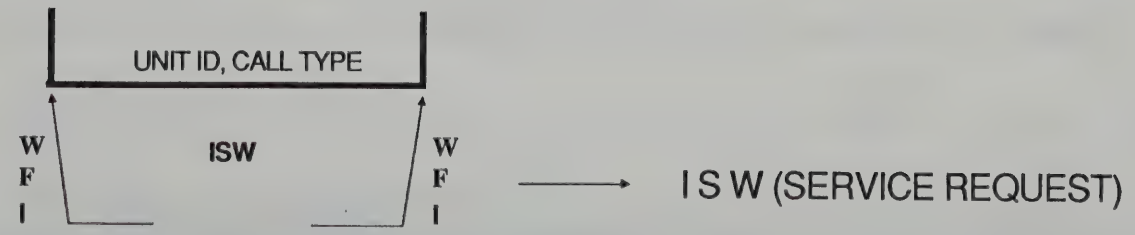
1. System ID sent at least every 3 seconds
2. Control channel data

D. If system ID and control channel frequency are not available, the unit will continue to scan.

E. Mic PTT - mobile polls PTT every 23 mSecs to see if depressed.



VOICE CHANNEL REQUEST



Channel Request

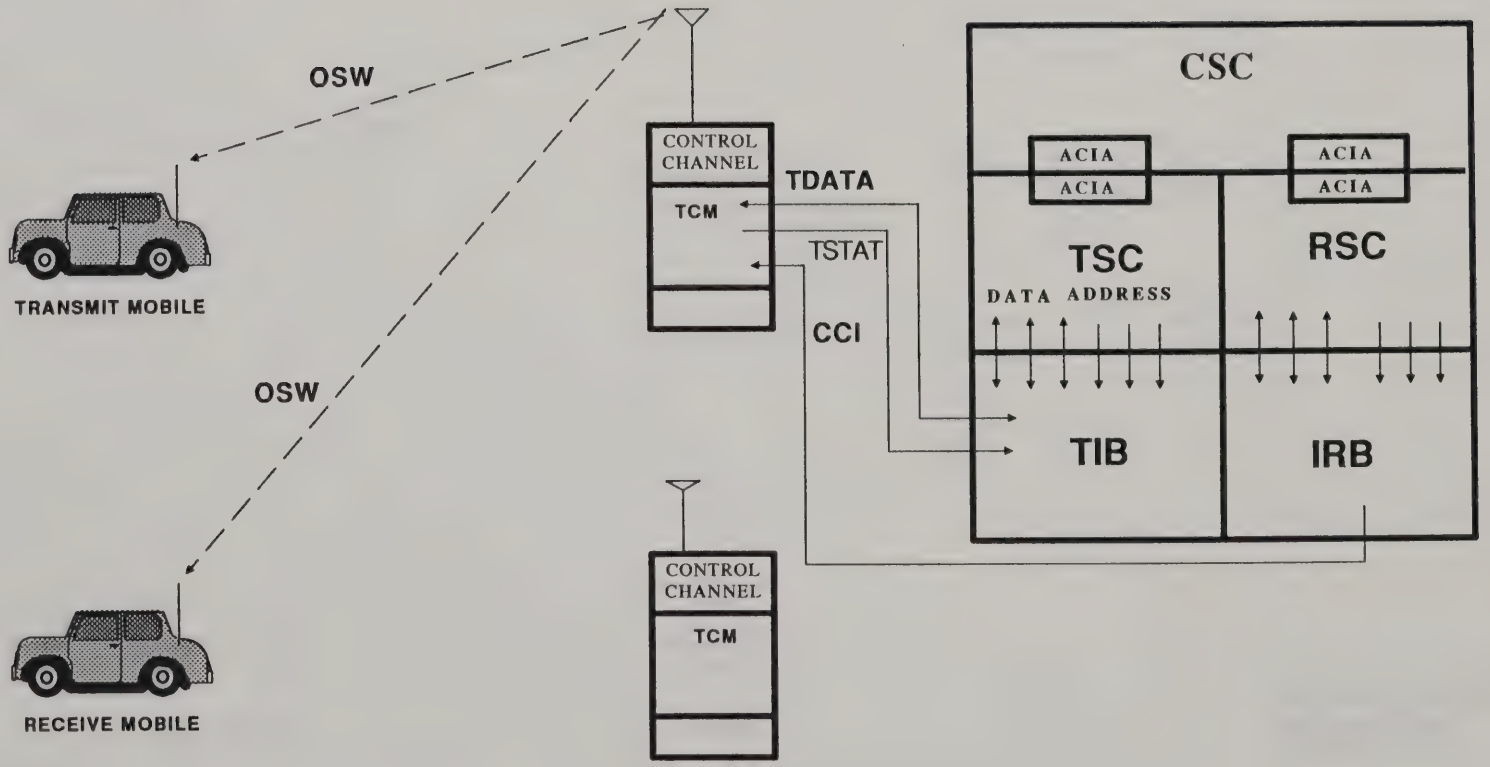
A. Sends Inbound Signaling Word (ISW) to request a voice channel.

B. ISW contains: 1) Unit ID (2) type call - group, system, individual.

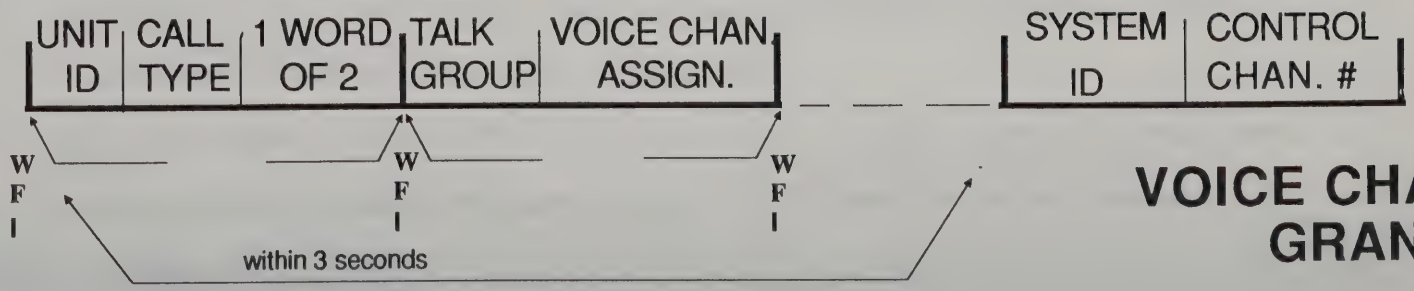
C. Inserted in queue by central controller.

D. Depending upon call type, may be one of several priority levels.

1. System/Announcement group calls
2. Recent system users
3. New users



OSW (VOICE CHANNEL ASSIGNMENT) SENT 4 TIMES IN A ROW, IN DUAL WORD FORMAT



VOICE CHANNEL GRANT

Channel Grant Outbound Signaling Word

A. Central controller sends Channel Grant (OSW) via control channel to the mobile. Sent twice in rapid succession.

B. OSW contains:

1. Individual ID of requesting unit
2. The group or talkgroup which is to be sent to the channel to receive.
3. Type of call - group, system, individual.
4. Voice channel assignment

C. Repeated randomly during radio conversation to update new mobiles. (Continuous assignment updating.)

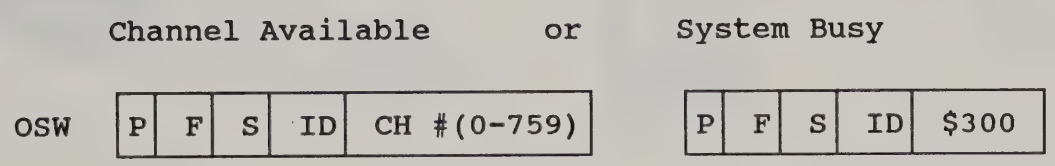
Channel Available

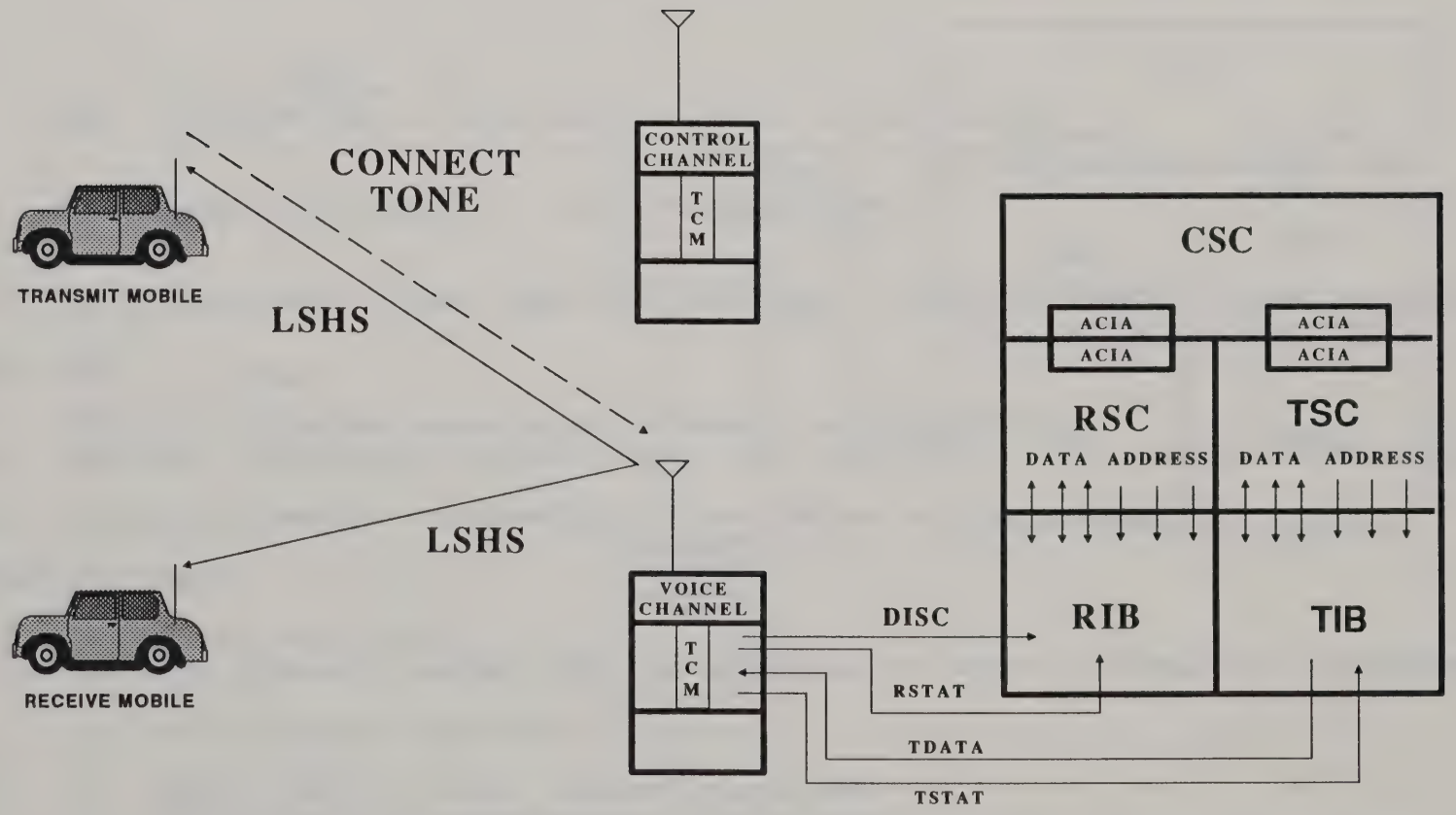
A. Initiating mobile receives OSW on designated control channel.

B. Switches to assigned voice channel (for group calls - all other radios in the same group or talkgroup move to the directed voice channel).

System Busy

A. If system busy, a busy light and tone will be seen and heard by the initiating mobile.





CONNECT TONE

LOW SPEED HANDSHAKE (LSHS)

CONNECT TONE
(105.88 Hz or SP)

Connect Tone

A. Mobile microphone is unmuted and voice transmission can begin.

B. Mobile transmits sub-audible Connect Tone (105.88 Hz) at low deviation, which is recognized by central controller to keep the channel connected and unmute the repeater.

C. Other Connect Tone frequency options: 76.7 Hz, 83.7 Hz, 90.0 Hz, 97.3 Hz, 128.5 Hz, 138.46 Hz.

LSHS (Connect Word)

A. Low speed handshake, 21 bits at 150 baud.

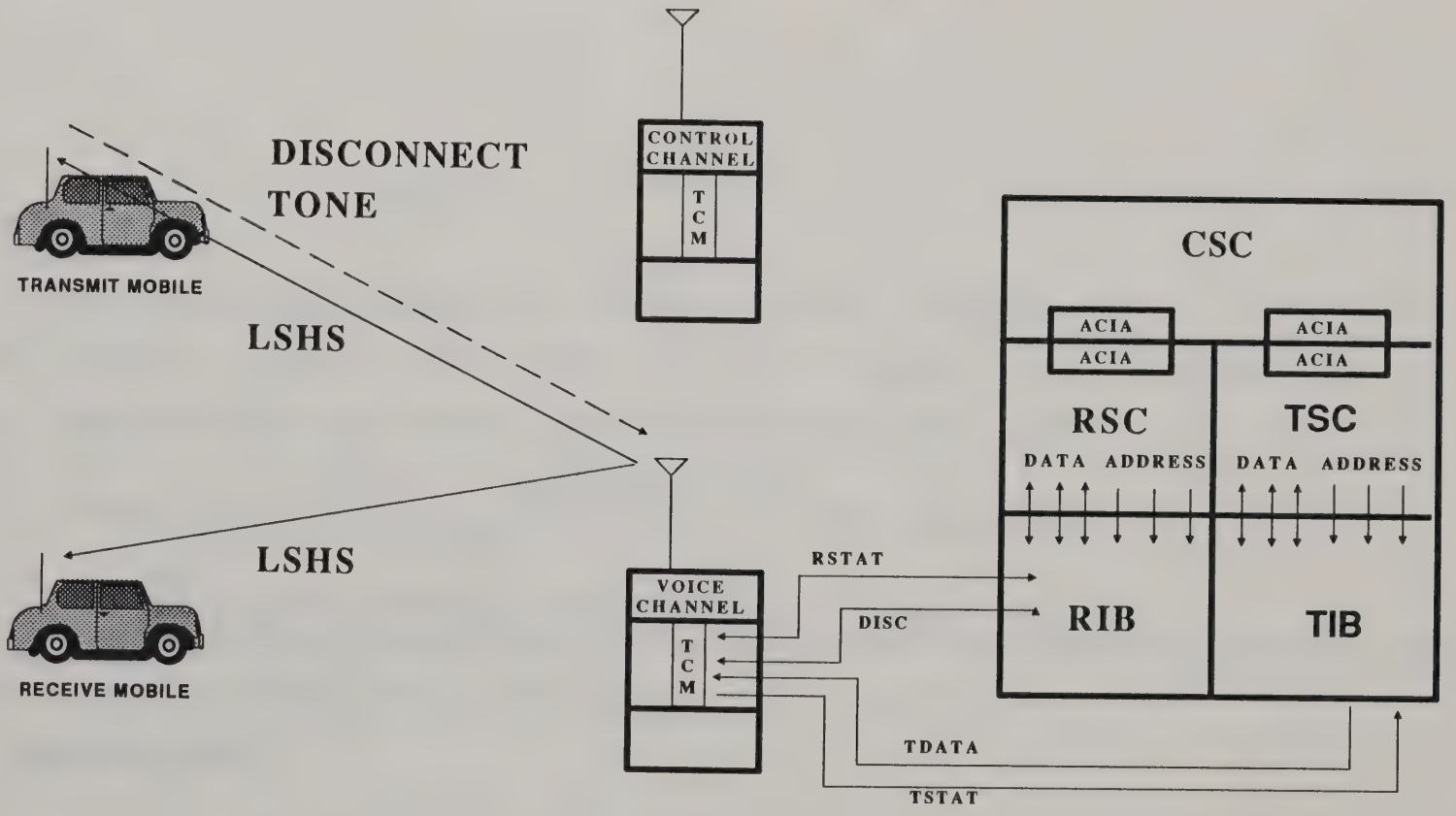
B. Used to unmute received audio and to hold receiving radios on assigned voice channel. To stay on voice channel, must continue to detect LSHS data.

First 21 bits of OSW (@150 baud) sent from central.

C. Receive radio will unmute after receiving two LSHS's.

D. To stay on voice channel, must continue to detect LSHS data words.

E. If not detected, radio will return to control channel.



DISCONNECT TONE

LOW SPEED HANDSHAKE (LSHS)

DISCONNECT TONE

(163.64 Hz, 200 mSECONDS)

End of Transmission

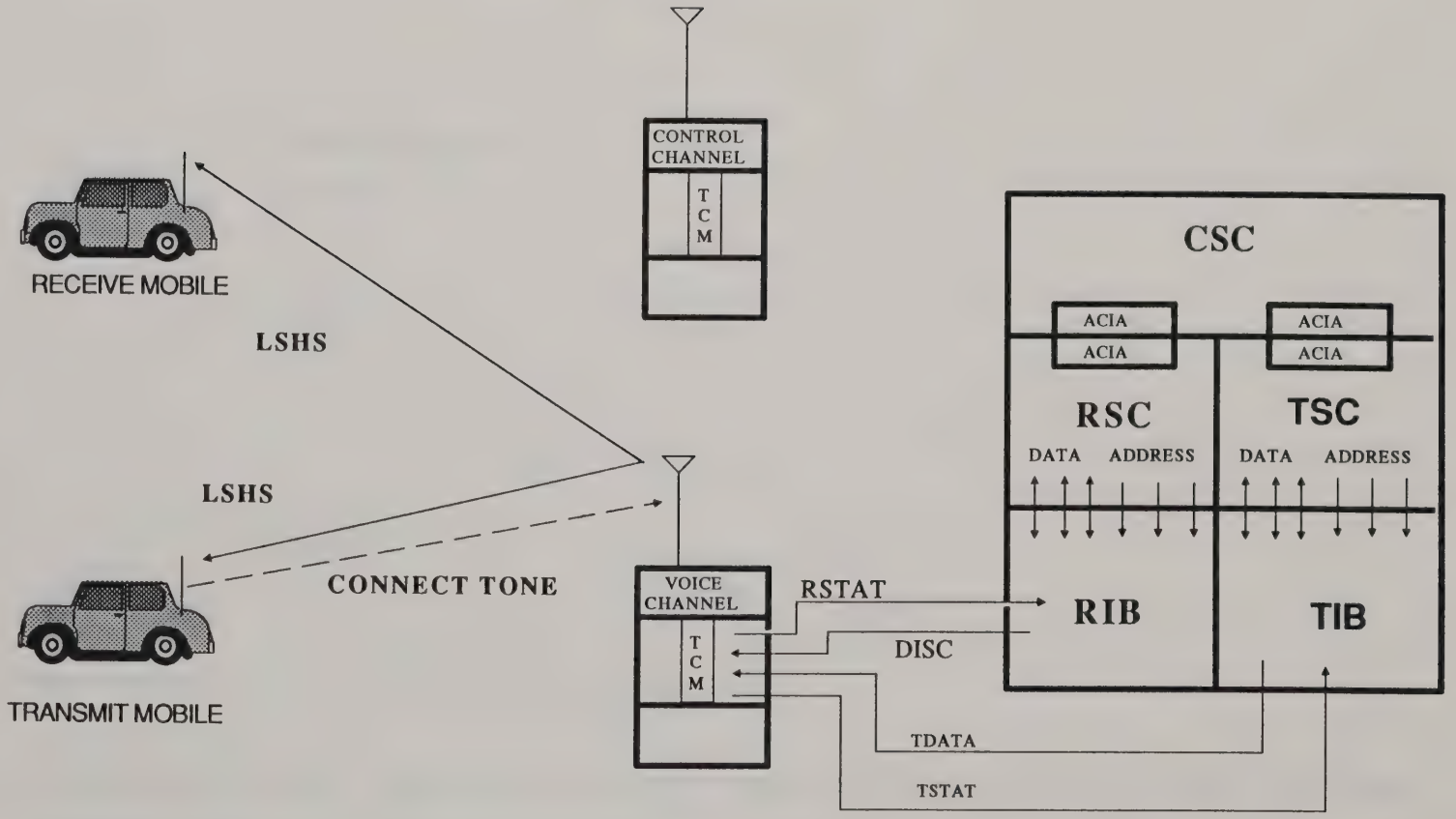
A. Release of PTT.

B. Mobile sends 200 mSec of Disconnect Tone.

C. 163.64 Hz at 750 Hz deviation.

D. In message trunking, the Central Controller detects the Disconnect Tone and begins a message time-out timer (typically 0-6 seconds, factory default set for 1 Sec.).

E. Transmitting unit switches to receive mode and unmutes after detecting LSHS.



CALL CONTINUATION

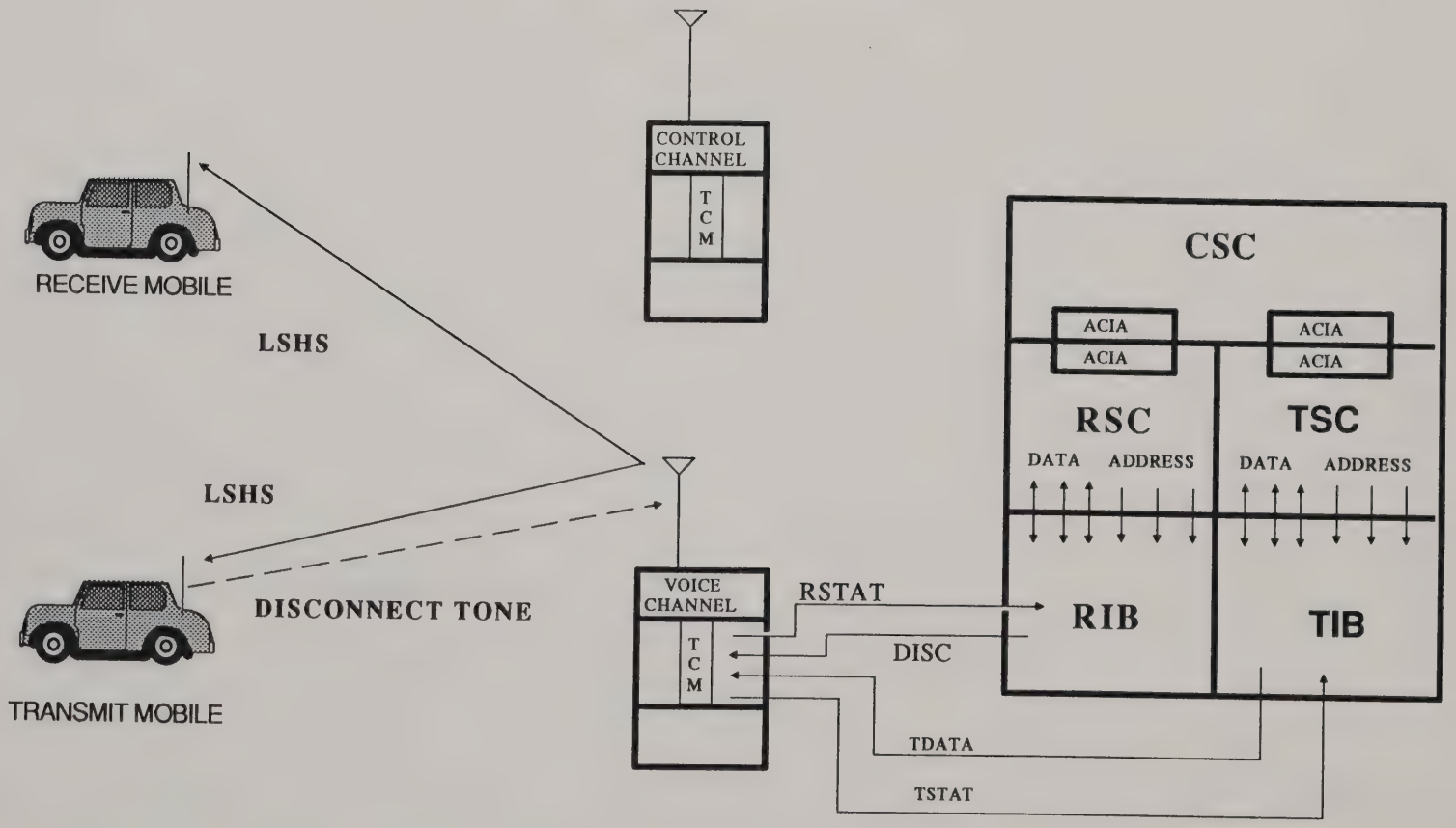
LOW SPEED HANDSHAKE (LSHS)

CONNECT TONE
(105.88 Hz or SP)

Call Continuation

A. Any other receiving radio on the same voice channel may respond to the original transmitting radio by pressing PTT and sending a connect tone plus voice. (Message Trunking)

B. Central controller will detect connect tone and reset message time-out timer.



CALL ENDING

LOW SPEED HANDSHAKE (LSHS)

DISCONNECT TONE
(163.64 Hz)

End of Transmission

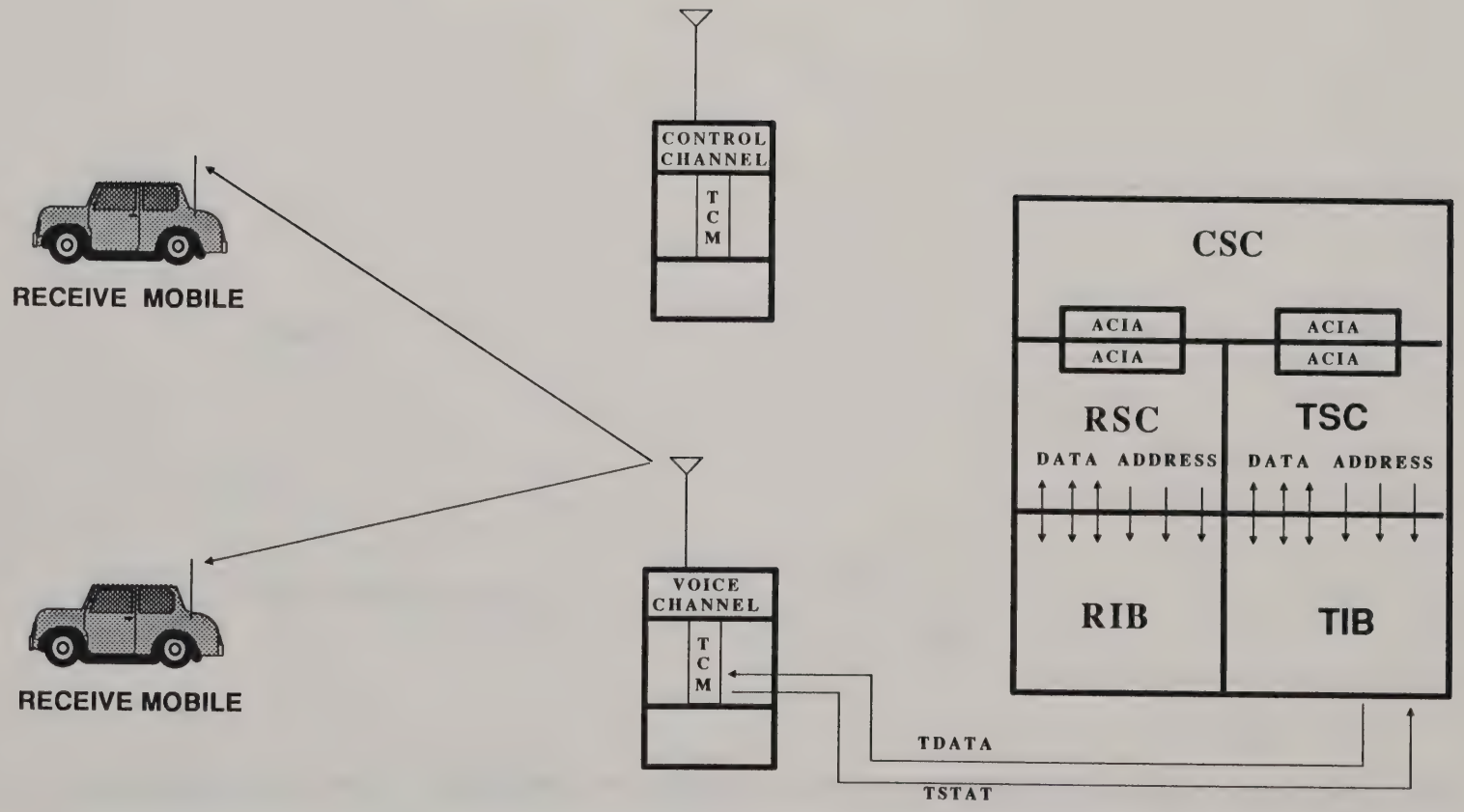
A. Release of PTT.

B. Mobile sends 200 mSec of Disconnect Tone.

C. 163.64 Hz at 750 Hz deviation.

D. In message trunking, the Central Controller detects the Disconnect Tone and begins a message time-out timer (typically 0-6 seconds, factory default set for 1 Sec.).

E. Transmitting unit switches to receive mode and unmutes after detecting LSHS.



DISCONNECT WORD

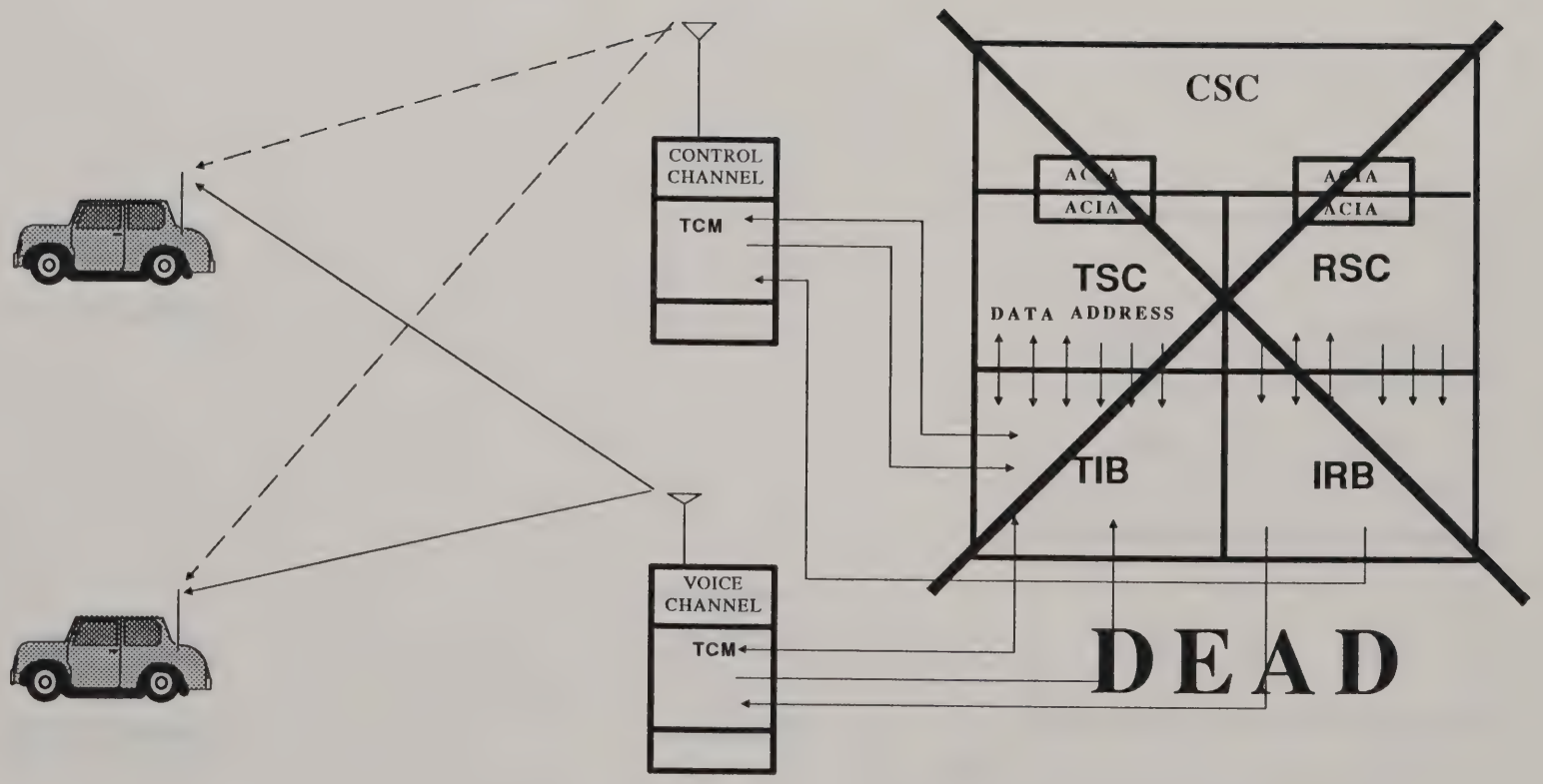
DISCONNECT WORD
(125 mSECONDS, 300 BAUD)

End of Talkgroup Traffic / Disconnect

A. Central Controller disconnects radios by sending 125 mSec of low speed Disconnect Word (300 Baud at 1 KHz deviation).

B. Radios mute and return to control channel when disconnect word is detected.

C. Channel becomes available for re-assignment.



Failsoft data produced by the Trunk Control Module in each Base Station

Failsoft

Failsoft

A. During normal system operation, the central controller toggles the base station required to keep the base station in the trunking mode.

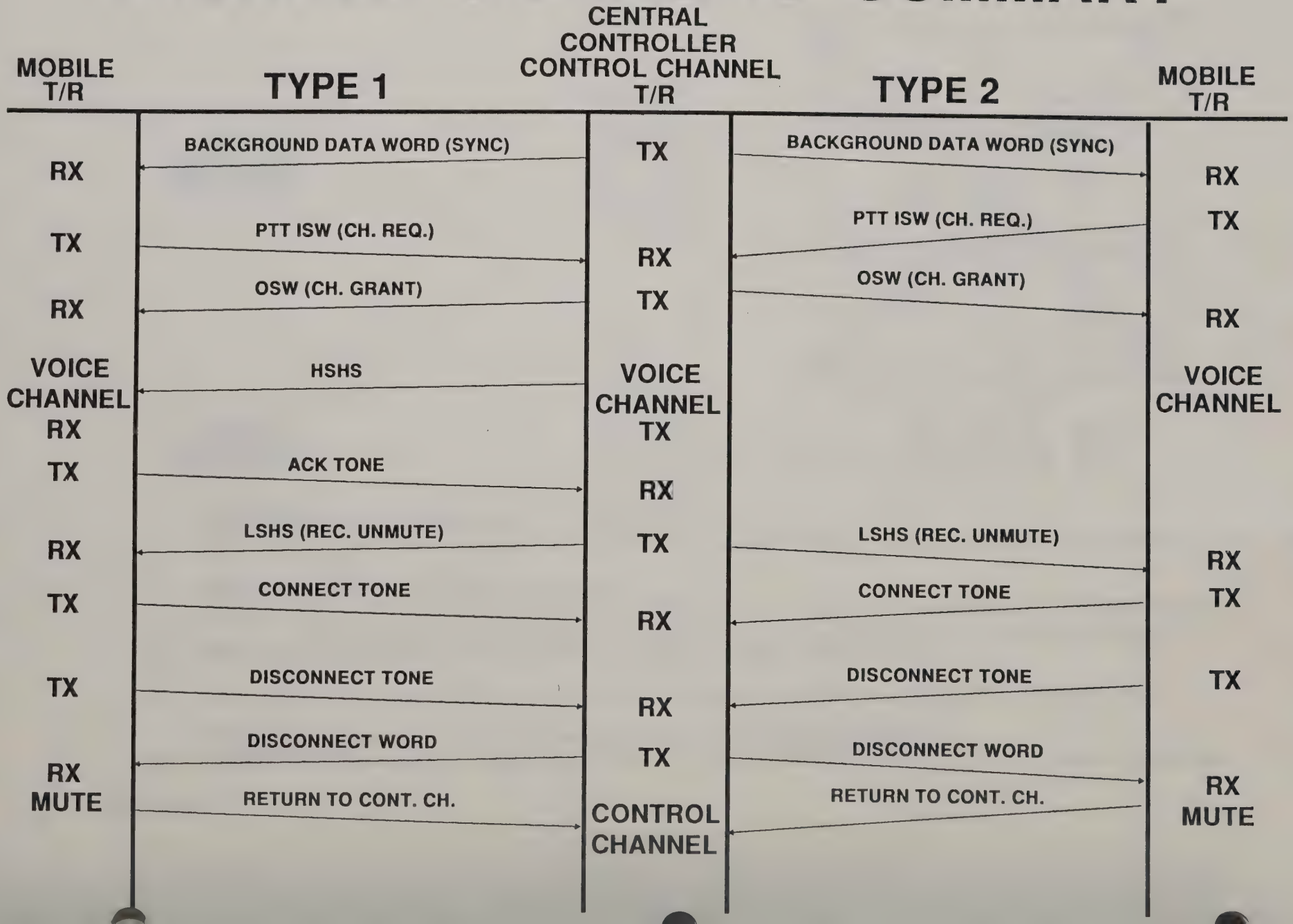
B. When toggling stops (CC failure), base stations revert to the failsoft mode.

C. Base station unmutes and sends out sub-audible data word.

D. Mobiles will respond to data word and unmute, allowing service to continue via community repeater type operation.

E. Base sends out 900 Hz tone for 280 mSec every ten seconds to alert the mobile user that the system is in failsoft.

TRUNKED SIGNALING SUMMARY



PRODUCT

SERVICE

BULLETINS

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

NOV 0 2 1989

PSB#: TX89036

Date: October 27, 1989

APC: 246, 483, 631, 677
Model: T__KEJ, KXJ, FDJ, FXJ

Options: W330AASP, W330ABSP

To: Distribution

From: Bubba Chambers

Subject: System 9000 & 9000E, "PA" & "EXRAD" Button Lockup

Symptom: Any of the above mentioned radios that shipped prior to October 1989, with the internal Public Address / External Radio option card, may exibit a "LOCKUP" of the PA and EXRAD buttons. The chances of this problem occuring on the std. 9000 radio are less likely than with the 9000E, due to less activity on the bus. If the symptoms are detected, the following fix will correct the problem.

Fix: Replace the option card software, version 1.01, with the new version 2.03.

Kit: YLN4575B (Internal Audio PA Card)

Part Number: Old - 0106709T35, New - 0106709T95

Circuit Symbol/Designator: U3 (on the option card)

NOTE: The above fix (software changeout) DOES NOT offer any other option enhancements, and should only be done to radios that exibit the described problem.

This Bulletin Authorizes replacement of the part listed above under the standard 1-year Parts Replacement, and up to 1/2 hour labor, not to exceed $35.00 per radio.

For any questions regarding this bulletin, please contact your local area Field Technical Representative.

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

SEP 1 1 198

PSB #: TX89034

DATE: SEPTEMBER 7, 1989

APC: ALL SYNTOR X

MODELS: ALL SYNTOR X

TO: Distribution

FROM: Keith Kolvitz

SUBJECT: Syntor X Analyzing Tip

KITS AFFECTED: HKN4100A, HKN4101A, HKN4116A, HKN4119A, TKN8087A, TKN8088A, HKN4240A, HKN4241A, HKN4256A, HKN4083A, HKN4187A, HKN4189A, HKN4304A

SYMPTOM: The cables listed above may have a wrong "WARNING LABEL". IF the label reads THIS CABLE WIRED FOR POSITIVE GROUND... and is colored red, it has a wrong label. The cable is wired correct for NEGATIVE GROUND, note that the red battery lead is on top when the cable is connected to the radio. Correct label for positive ground is black. Cables shipped in July and August may have a wrong label. Cables shipped after August 1989 will have the fix incorporated.

This bulletin is intended as a SERVICE AID ONLY and does not authorize any time.

If you have any questions, please contact your area Field Technical Representative.

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

PSB: TX89031

DATE: Aug.23, 1989

PRODUCT: SYS 9000 & 9000E VHF SYNTOR-X

APC: 483,621,631,677

MODELS: T_3KEJ & KXJ, T_3FDJ & FXJ

KITS: HCN1033D, HCN1036E & HCN1045A

TO: Distribution

FROM: Bubba Chambers

SUBJECT: SELF CHECK Control Head RFI

NOTE: This Bulletin is being issued to extend the expiration date of PSB TX89016 from August 1st, 1989 to January 1st, 1990. Please refer to the bulletin listed above for details of the rework.

If you have any further questions, please contact you local Field Technical Representative.

Regards,

Bubba Chambers

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

JUN 1 2 1989

PSB #: TX89023

DATE: May 30, 1989

APC: 631

Model: T45KEJ5G__AK

Expiration: August 1989

TO: Distribution

FROM: Keith Kolvitz

SUBJECT: Software Bug Fix

KIT: 01-80752T80

SYMPTOM:
When trying to key the System 9000 Trunk radio while scan is turned on, the unit will honk and the transmissions are delayed. This bug only occurs when:

1. Programmed with a full scan list
2. The selected personality has a large size code
3. Scan is turned on
4. The radio is receiving on the selected subfleet
5. The radio is PTT ID.

All five of these conditions must be true in order to exhibit the bug. The software that would exhibit this problem are:

01-06707T14	Ver S2.00
01-06707T38	Ver S2.10
01-06707T34	Ver S2.20
01-06707T71	Ver S3.10
01-80747T88	Ver 3.10

FIX:
On units exhibiting all five conditions and having one of the software versions listed above, replace the software with 01-80752T80. Replacement software is available from Midwest Service Depot (312)576-5760. Reference this bulletin and return the defective firmware to Midwest Depot for a "no charge" replacement.

This bulletin authorizes one half hour or a maximum of $35 per unit to an authorized Motorola Service Station.

For any problems or questions, please contact your local Field Technical Representative.

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX89020

DATE: May 26, 1989

APC: 621,677

PRODUCT: Sys-9000 Conv & 9000E

Models: T__KXJ7J04_K, T__FXJ7J04_K

Option: W988ACSP, W224AASP

Kit: HLN5234B

TO: Distribution

FROM: Bubba Chambers

SUBJECT: System 9000 Dual Radio/Securenet Compatibility

SYMPTOM:
Syntor-X System 9000 radios with options W988 or W224, that shipped prior to May 15, 1989, are not compatible for use with Securenet Operations. Any radios that shipped before the listed date will require the following Securenet software upgrade.

FIX:
Change out the Securenet option software, on the HLN5003B option card, with the new recommended version.

P/N: Old - 0180751T73 (ver. 3.01) New - 0180752T75 (ver. 3.02)

Circuit Symbol/Location: U1 on the HLN5003B Securenet option card

NOTE: This bulletin is being issued as Service Aid only and does not authorize any time. The software can be replaced through National Parts Department at no charge, under the one year parts warranty.

Any problems or questions, please contact your local Field Technical Representative.

/plw

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

PSB #: TX89019

DATE: May 22, 1989

APC: 483,621,677

Models: All 9000 and 9000E

TO: Distribution

FROM: Keith Kolvitz

SUBJECT: Distorted Audio, Kit HSN1018

SYMPTOM:
Units that exhibit distorted audio may have a bad speaker.

DETAIL:
Look at the date code on the trunion, if the date code is between 9026 and 9030, open and check inside on the magnet for date codes of 8812 and previous.

FIX:
Replace only speakers exhibiting distorted audio and having trunion with date codes of 9026 through 9030 and speaker date codes of 8812 and previous. Replacement speakers are available from NPD. Reference this bulletin and return the defective speaker to NPD for a no charge replacement speaker.

This bulletin authorizes one half hour or a maximum of $35 per unit to an authorized Motorola Service Station.

Any problems or questions, please contact your local Field Technical Representative.

/plw

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX89017

DATE: May 19, 1989

PRODUCT: All Syntor-X
& 9000E

TO: Distribution

FROM: Keith Kolvitz

SUBJECT: Reference Oscillators, Kits 5180291B02 and 5180291B07

SYMPTOMS: Unit out of lock, or intermittent

FIX:

The Syntor-X Engineering group has determined that units shipped between October 1988 through February 1989 may have a reference oscillator exhibiting intermittent or out of lock at cold temperatures. Check the reference oscillator (U608 on the RF board) for date code. Date codes 8842 through 8906 should be replaced. Units shipped after 4/8/89 will not exhibit this problem. Replacement oscillators are available from NPD. Reference this bulletin and return the defective oscillators to NPD for a no charge replacement oscillator.

This bulletin authorizes one half hour or maximum of $35 per unit to an authorized Motorola Service Station.

For any problems or questions, contact your local Field Technical Representative.

/piw

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

APR 12 1989

PSB #: TX89016

DATE: April 7, 1989

PRODUCT: Syn-X Sys. 9000
& 9000E

APC: 483, 621, 631, 677

MODELS: T_3KEJ, T_3KXJ,
T_3FDJ, T_3FXJ

KIT: HCN1033D, 1036E,
& 1045A

EXPIRATION: August 1, 1989

TO: Distribution

FROM: Bubba Chambers

SUBJECT: Systems 9000 Control Head RFI Problems

SYMPTOMS:

Syntor-X VHF Systems 9000 radios shipped prior to January 1989 may exhibit RFI problems in the control head during Push to Talk (PTT). The RFI comes into the control head through the mic coil cord causing it to reset and display "SELFCHECK".

To correct this problem, if found, the following fix has been recommended.

FIX:

Add a 220pF cap across the gate to anode of Q4 on the controller board of the control head (see attached diagrams).

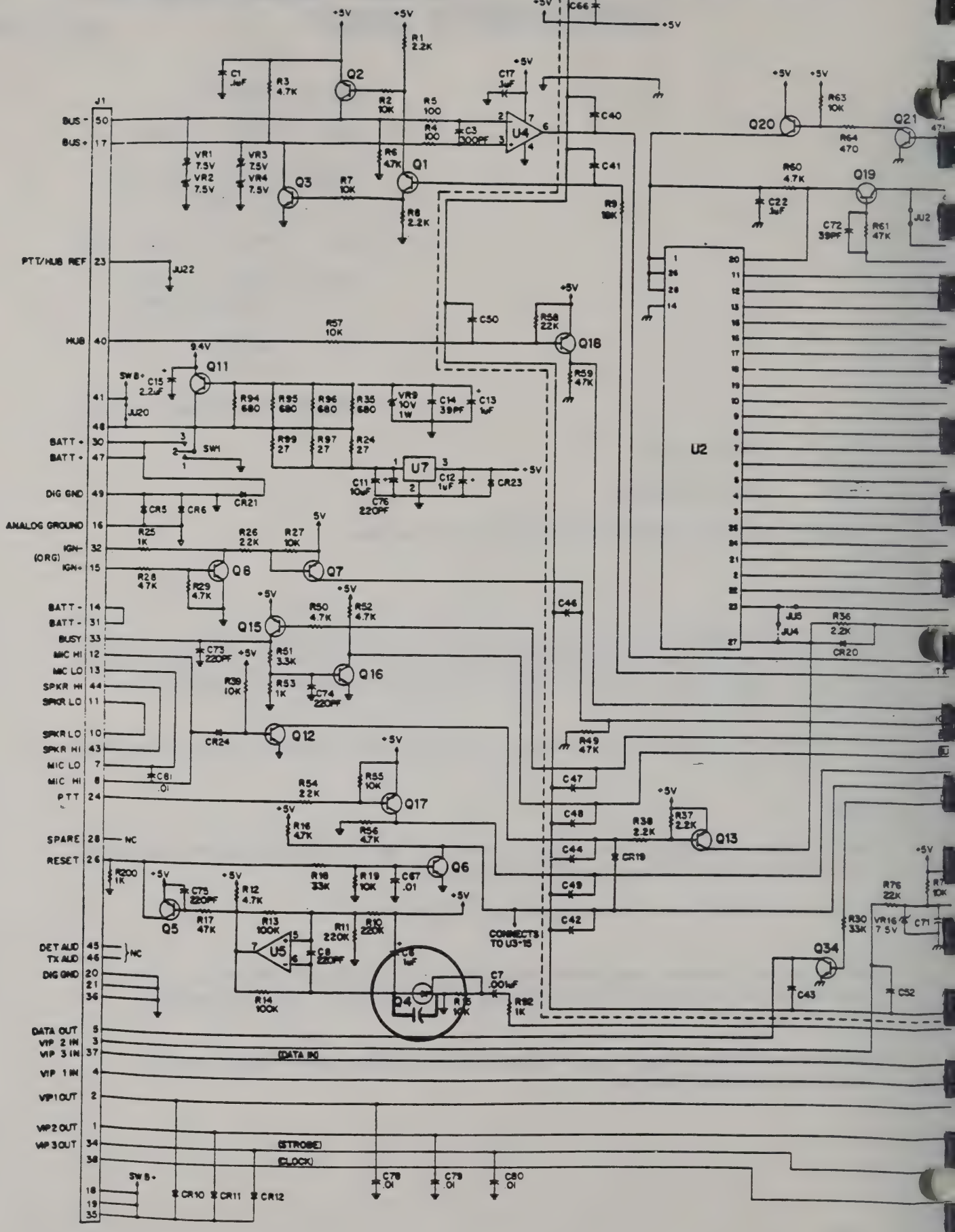
P/N 21-11015B05 ("Q4" on HLN4907C and HLN5104D)

This bulletin authorizes parts and labor to implement this fix. Parts available at National Parts and Labor up to 1/2 hour not to exceed $35.00 per unit.

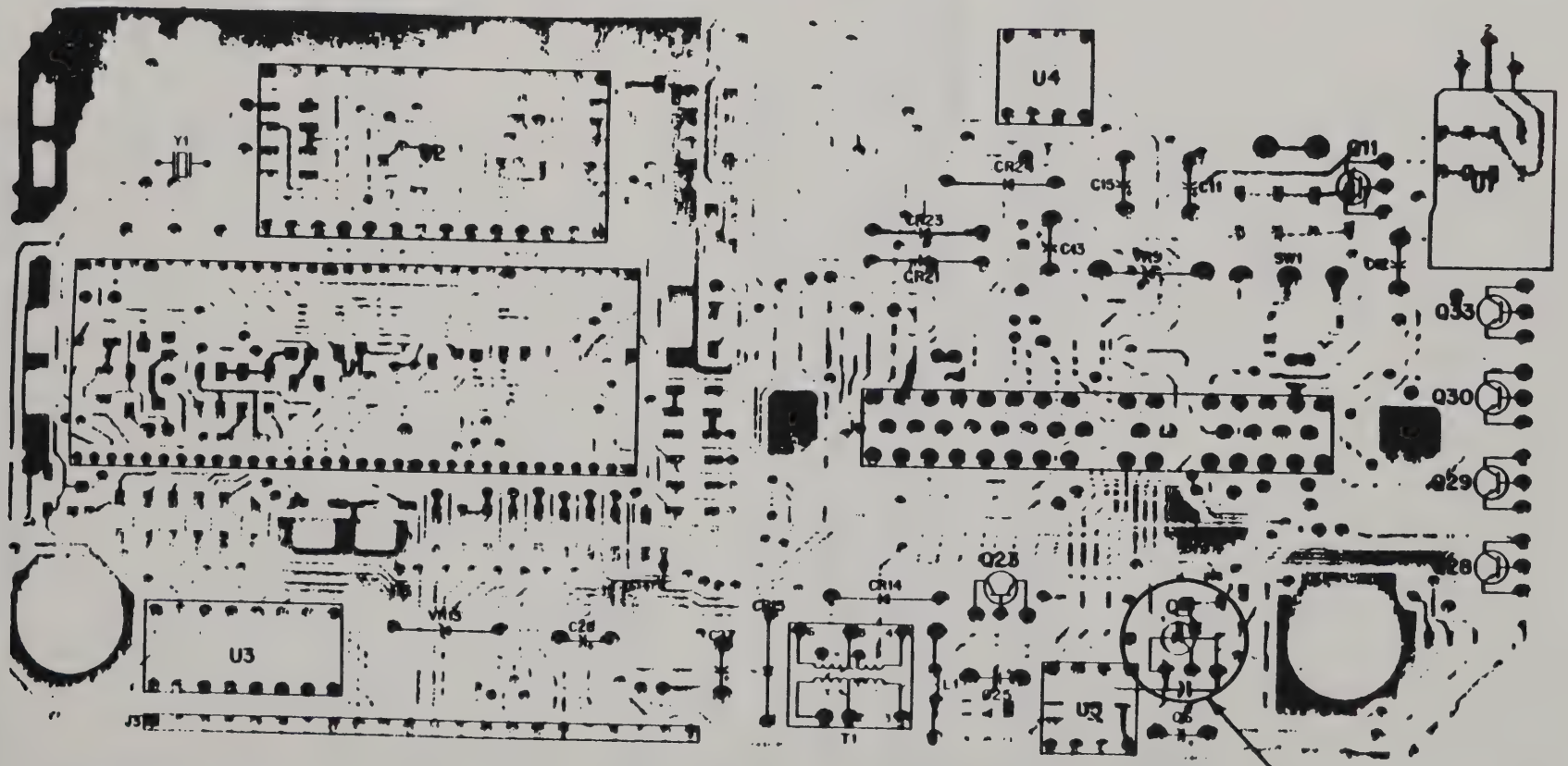
For any questions regarding this bulletin, contact your local Field Technical Representative.

/plw

CONTROLLER BOARD



CONTROLLER BOARD



COMPONENT SIDE VIEW

SOLDER SIDE — GDW-2516-B
COMPONENT SIDE — GDW-2517-B
OVERLAY — GDW-2519-C

220pF
(21-11015B05)

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

MAR 27 1989

PSB #: TX89014

DATE: March 14, 1989

APC: 677

MODELS: __FDX

EXPIRATION DATE: 6-1-89

TO: Distribution

FROM: Keith Kolvitz

SUBJECT: Microprocessor Lock-Up Problem

PRODUCT: 9000E

SYMPTOM: Control head display would lock-up, no button function

KITS: HLN4925_ Personality Board and HLN5216A Trunking option card

FIX: On the HLN4925_ personality board, changeout R543 from 110K to 100K (P/N 06-11077B23). Ont he HLN5216A turnking option card, R30 needs to change to 47K and R21 to 68K (06-11077B15 and B19 respectively).

This bulletin authorizes up to a maximum of 1/2 hour, not to exceed $35.00 per unit. Further, it is recommended that these parts be changed on an "as needed" basis because not all units will exhibit this problem.

If you have any questions, please contact your local Field Technical Representative.

Thanks,

Keith Kolvitz

/plw

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

FEB 0 9 1989

PSB #: TX89005

DATE: January 24, 1989

APC: 246,483,621,677

MODELS: All

Expiration Date: 4-1-89

TO: Distribution

FROM: Bubba Chambers

SUBJECT: Product Service Bulletin TX88016 Update (MPU Oscillator Start-Up)

PRODUCT: System 9000 Conventional & 9000E

KIT: HLN5299_ Personality Board

SYMPTOM: The bulletin referenced above, addressed a problem with MPU lock up. The Sys-9000 control head would exhibit constant "SELF-CHECK" and/or "BLANK DISPLAY". We found that after performing the rework, some of the units still exhibited a blank display. The following fix will correct this problem.

FIX: On the HLN5299_ personality board, located on the component side in the area of U500, changeout a 75pF chip cap to 27pF.

Old P/N 2113740B46, New P/N 2113740B35

CRTSYB (C511)

The parts mentioned in the TX88016 Bulletin and this one are replaceable through Motorola's Standard One Year Parts Warranty Program.

This bulletin authorizes a maximum of 1/2 hour labor, not to exceed $35.00 for the cap change, and up to a maximum of 3/4 hour, not to exceed $50.00 for implementation of both TX88016 and TX89005.

For any other questions concerning this bulletin, please contact your area Field Technical Representative.

Bubba Chambers

/plw
(2)

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

PSB #: TX88016

DATE: November 4, 1988

TO: Distribution

FROM: Bubba Chambers

SUBJECT: MicroProcessor Oscillator Start-Up Problems

THIS PROBLEM WILL NOT BE FOUND IN ALL SYSTEM 9000 RADIOS WITH THE HLN5299 BOARDS. Only those radios exhibiting the symptoms listed will require the rework.

PRODUCT: System-9000 Conv. & 9000E
APC: 246,483,621,631 and 677
MODEL: TX4KEJ, TXXKEJ, TXXKXJ, TXXFDJ, TXXFXJ
KIT: HLN5299 Personality Board
CIRCUIT: Crystal Pull
VINTAGE: Units shipped before 11-1-88

SYMPTOMS:
One or more of the following symptoms will be noticed during ignition start-up or turning the control head off and then back on again.

1. Blank control head display
2. Indicator and back lights still on
3. Unusual long time to come out of "self check"
4. Hangs up in "self check"

CAUSE:
This problem appeared with the introduction of the new HLN5299 personality board. The cause of the problem stems from the redesign of the crystal pull circuit on the personality board. To allow the oscillator to properly start, some DC leakage is needed through diodes CR515 and CR516 so that DC impedance to ground is present on power up.

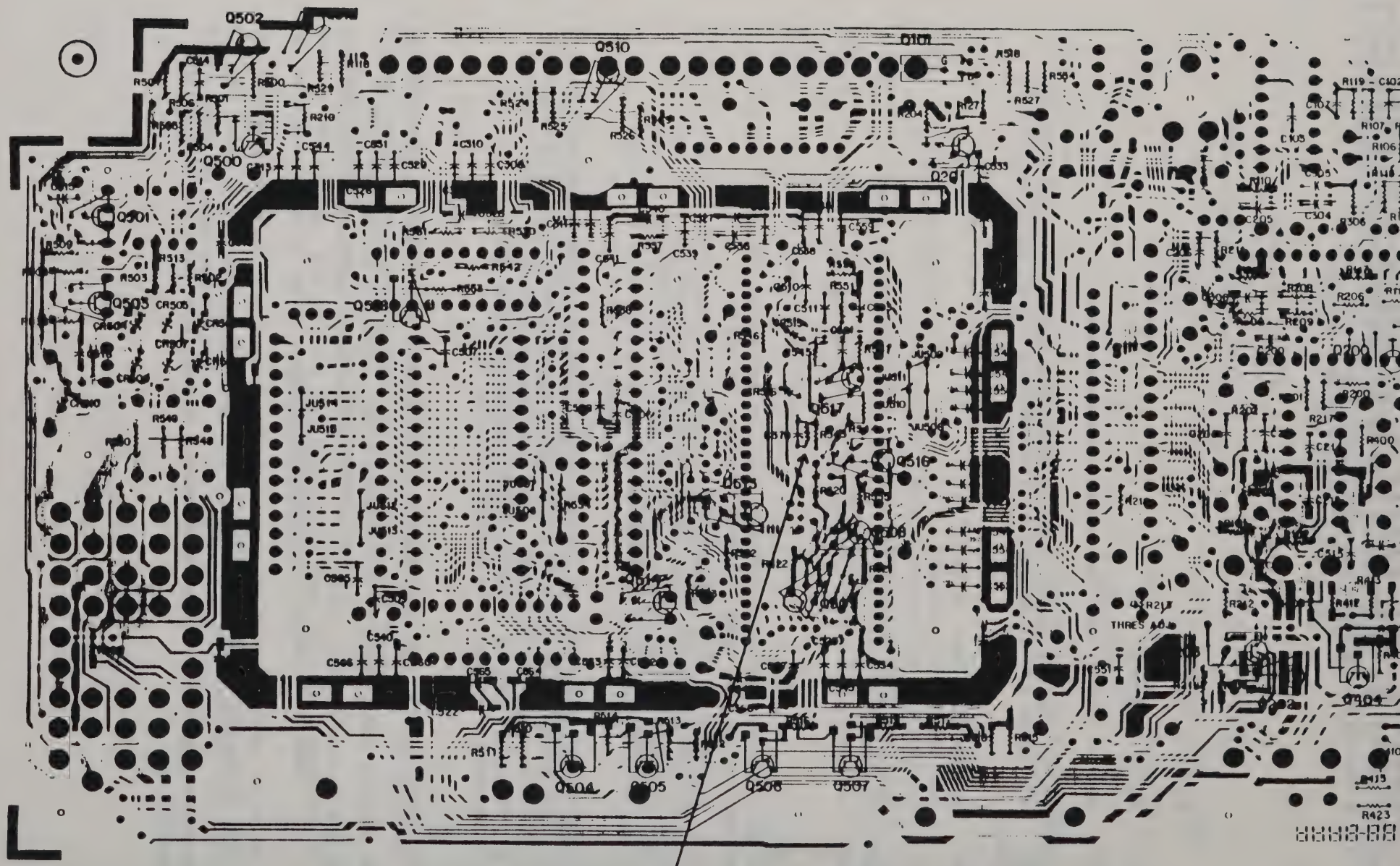
FIX:
Person. Board Rework: Add an 82K chip resistor (P/N 0611024A95) across C570

Common Circuit Board Rework: Verify that C1007 (47uF) is NOT a 10v part, if so, change out to a 20V part (P/N 2384538G06)

(See attachments for part locations)

This bulletin authorizes up to a maximum of 1/2 hour, not to exceed $35.00 per unit, for those out of the 120 day warranty period.

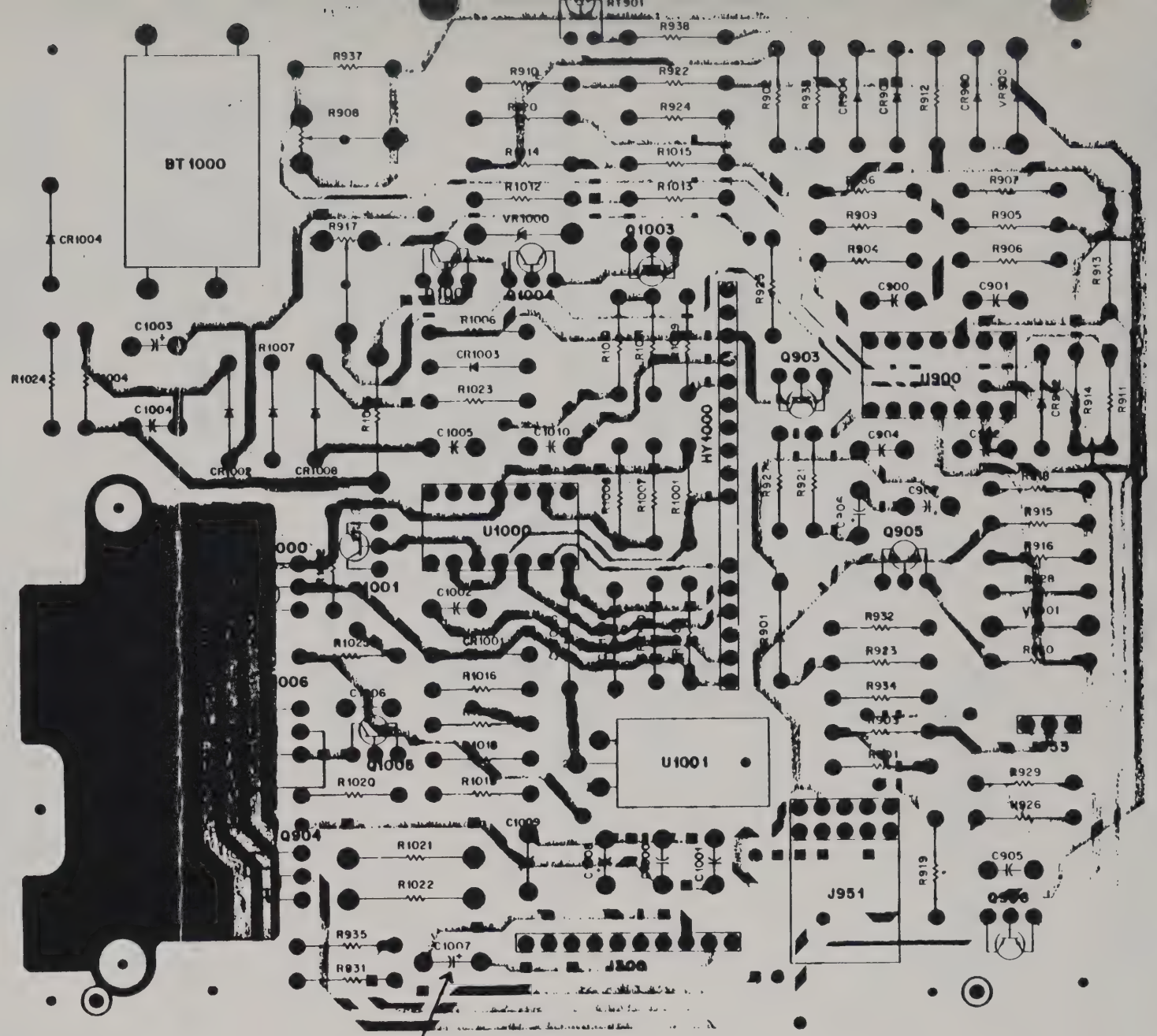
If there are any further questions, please contact your Area Field Technical Representative.



SHOWN FROM SOLDER SIDE

SOLDER SIDE	GEW-4555-0
COMPONENT SIDE	GEW-4556-0
OVERLAY	GEW-4557-0

Add 82K chip resistor across C570
P/N: 0611024A95



SHOWN FROM COMPONENT SIDE

Check for 20V part at C1007, if not replace w/ P/N: 2384538G06

SOLDER SIDE	GEW-4571-0
COMPONENT SIDE	GEW-4572-0
OVERLAY —	GEW-4573-0

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX88012
DATE: September 26, 1988

FT. WORTH PRODUCT SERVICES

PHONES: (817)232-xxxx or Ditel 729-xxxx (xxxx = extension)

FAX: x6081 POST: FW0303

OFFICE HOURS: 8:30 am - 4:00 pm (CST)

Phil Florles- Supervisor, Certified Quality Engineer, x6467

- Customer complaint control and reporting
- PSB/SRN approval, distribution, control
- Extended warranty administration
- Product Services performance measurement
  - * Internal audits
  - * External surveys

Joe Sblewak - Customer Satisfaction Manager x6387
George Manos - Manufacturing Quality Manager x6328

Bubba Chambers - x6389
Securenet - APC 412,621,677
Syntor-X 9000 - 246,463,483
(not Trunking)
Mitrek - 433,447,478
Maratrac - 776

Keith Kolvitz - x6242
Syntor-X Trunking
APC: 243,429,481,492
Syntor-X 9000 Trunking - 631
Syntor-X 9000 E Trunking - 677
Syntor-X Conventional (no 9000)
246,463,483

Lee Webb - x6243
Spectra - APC 604,617
Mostar U/V only 436
NOTE: Mostar 800 MHz is a Mt. Pleasant product
AVL - Fixed and Mobile - 220,280
Epson programmner - 583

FYI ONLY:
MCX products are Canada products
Product Services provided by:
Bob Pritchett (416)499-1441
Ditel 325-3114
Daniel Puente - Quality Manager
(416)499-1441 Ditel 325-3989

-- OVER --

PRODUCT SERVICES RESPONSIBILITIES

SORTED ON APC & MODEL

APC	PRODUCT	MODEL	PSE
220	AVL MOBILE	H1051	LEE WEBB
243	SY-X-1 TNK	T_5VBJ5G	KEITH KOLVITZ
246	SY-X 9K NON-TNK	T_4KEJ	BUBBA CHAMBERS
246	SY-X UHF	T_4VBJ	KEITH KOLVITZ
280	AVL FIXED	H1098	LEE WEBB
412	SECURENET	T__VXJ	BUBBA CHAMBERS
429	SY-X TNK CONSOLE	L__VBB	KEITH KOLVITZ
433	MITREK	T__JJA	BUBBA CHAMBERS
436	MOSTAR U/V	D__TLA	LEE WEBB
447	MITREK CONSOLE	L__JJB	BUBBA CHAMBERS
463	SY-X 9K NON TNK	T_5KEJ	BUBBA CHAMBERS
463	SY-X 800 CONV	X__VBA	KEITH KOLVITZ
478	MITREK 800	T_5JJA	BUBBA CHAMBERS
481	SY-X-2 TNK	T_5VSJ	KEITH KOLVITZ
483	SY-X 9K NON TNK	T__KEJ	BUBBA CHAMBERS
483	SY-X LB/VHF	T__VBJ	KEITH KOLVITZ
492	SY-X-3 TNK	T_5VUJ	KEITH KOLVITZ
583	EPSON PROG	Y1069	LEE WEBB
604	SPECTRA DUAL MODE	D__KGA	LEE WEBB
617	SPECTRA CONV	D__KMA	LEE WEBB
621	SECURENET 9K	T__KXJ	BUBBA CHAMBERS
621	SECURENET	T__VXJ	BUBBA CHAMBERS
631	SY-X 9K TNK P+	T45KEJ5G26	KEITH KOLVITZ
631	SY-X 9K TNK	T45KEJ5G27	KEITH KOLVITZ
631	SY-X S.N. P+	T__VKJ	KEITH KOLVITZ
631	SY-X SMART NET DM	T__VLJ	KEITH KOLVITZ
631	SY-X DUAL MODE P+	T__XAJ	KEITH KOLVITZ
677	SY-X 9K-E TNK	T__FDJ	KEITH KOLVITZ
677	SY-X 9K-E TNK SECURE	T__FXJ	BUBBA CHAMBERS
776	MARATRAC	T__XTA	BUBBA CHAMBERS

NOTE: "SP" APC'S ARE ASSIGNED BY INCREASING THE 1st DIGIT BY ONE
EXAMPLE: 433 IS THE APC FOR MITREK & 533 IS FOR MITREK-SP

ABBREVIATIONS USED:

9K = SYNTOR-X 9000
9K-E = SYNTOR-X 9000E
AVL = AUTOMATIC VEHICLE LOCATOR
CONSOLE = CONSOLETTE
CONV = CONVENTIONAL
DM = DUAL MODE
LB/VHF = LOW BAND & VHF
PROG = PROGRAMMER
P+ = PRIVACY PLUS
SY-X = SYNTOR X
S.N. = SMART NET
TNK = TRUNKING

SERVICE AND REPAIR NOTES

bulletin

MOTOROLA
COMMUNICATIONS AND ELECTRONICS, INC.
A SUBSIDIARY OF MOTOROLA, INC.

TECHNICAL INFORMATION CENTER • 8000 W. SUNRISE BLVD. • FT. LAUDERDALE, FL 33322 • (305) 475-6170

PORTABLE PRODUCTS
SRN-F1052
February, 1988

STATIC CONTROL EQUIPMENT FOR SERVICING "ESD" SENSITIVE PRODUCTS

By now, all of us are aware of the dangers that electrostatic discharge (ESD) can have on the products we service. As you may recall, you need a static potential of at least 4,000 volts to feel the discharge and 10,000 volts to see it. But did you know that with the advent of microtechnology, electronic components can be damaged or destroyed by ESD voltages as low as 20 volts.

Fortunately with an effective static-safe work area, repair returns can be reduced to less than 1%. By the implementation of the following equipment (which is the minimal static control equipment for service shop work stations), you will save money and improve customer/service shop relationships.

Below is a list of static control equipment specifically related to servicing portables. Nevertheless, it also applies to servicing other products, but may not cover all their particular requirements.

STATIC CONTROL EQUIPMENT FOR EACH WORK BENCH:

Part Number	Description
01-80386A82	*Anti-Static Kit (includes the next five items)*
66-80387A95	*Replacement 2' X 4' Static Control Table Mat, includes Ground Cord*
66-80387A96	*Replacement 4' X 6' Static Control Floor Mat, includes Ground Cord*
66-80387A97	*Floor Mat Ground Cord, 15'*
66-80334B36	*Table to Floor Mat Ground Cord, 10' with Clip*
42-80385A59	*Conductive Wrist Strap, 5' Coil Cord*
66-80388A75	*Rigid Static Control Table Mat*

STATIC CONTROL EQUIPMENT FOR SERVICE SHOP WORK AREA:

Part Number	Description
01-80371B20	*Air Ionizer - static eliminator with a heater and variable fan control.*
Model CP912	*Air Ionizer- available from Charleswater Products, Inc.; 93 Border St.; West Newton, MA 02165 (617) 964-8370*

STATIC CONTROL EQUIPMENT FOR ON-SITE SERVICING:

Part Number	Description
01-80371B21	*Static-Dissipative Field Service Kit (3M Model 8501)*

STATIC CONTROL EQUIPMENT FOR SOLDERING/DESOLDERING:

Part Number	Description
RSX-4057A	*Surface Mounted Component/IC Removal/Rework Station* (117VAC)*
RSX-4058A	*Surface Mounted Component/IC Removal/Rework Station* (220VAC)*
01-803282A44	*Digital Readout Soldering Station (117 VAC)*
01-803282A45	*Digital Readout Soldering Station (220 VAC)*
RSX-1008A	*Zero Voltage Soldering Station (117 VAC)*
RSX-1008A/240V	*Zero Voltage Soldering Station (240 VAC)*
01-80386A81	*Miniature Digital Readout Soldering Station (117 VAC)*
01-80386A86	*Miniature Digital Readout Soldering Station (220/240 VAC)*
01-80382A57	*Cordless Solder Iron (117VAC)*
01-80382A58	*Cordless Solder Iron (220VAC)*
01-80333B61	*Power Desoldering and Soldering System (117VAC)*
01-80333B62	*Power Desoldering and Soldering System (220VAC)*

**Accessories must be ordered separately.*

If applicable, enter this information or note this bulletin number and subject material in the appropriate equipment instruction manuals and make necessary schematic diagram changes.

Enter this bulletin in the correct MASTER and CLASSIFIED INDICES for future reference.

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX870020
DATE: November 6, 1987

TO: Distribution

FROM: Ft. Worth Product Services

SUBJECT: Service Manuals

Starting with Mitrek products this month and Syntor-X (this includes Syntor-X Consolettes) by end of year, Mobile Products will no longer automatically ship service manuals.

Exceptions:
These manuals will continue to ship as before:

- All new products (that is, on the market less than 2-3 years). Currently, this includes:
  - Syntor-X 9000 & 9000E
  - All Spectra products
- Accessory manuals
- Option manuals
- Supplemental manuals
- Installation manuals
- Operator manuals

Should you require a service manual, a preprinted, postage paid, Manual Request Card will be packed with the first and every 10th radio in an order. Fill it out and return it to the Ft Worth Bindery. Be sure to completely fill out the request card as you will receive manuals only for the model and options you list.

/plw

MOTOROLA SERVICE MANUALS

FOR TECHNICIANS' USE ONLY; a service manual containing schematics and circuit board diagrams for testing and servicing is available. Order one by filling out and mailing this card.

Your Motorola *SYNTOR X*™ or *Mitrek*™ radio comes with an INSTALLATION MANUAL and OPERATOR'S MANUAL that explains how to install and operate the unit.

Model No.: _____ Serial No.: _____
Phone: ( ) _____ Comments: _____
Option Nos.: _____ _____
(List all _____ _____
options _____ _____
that require _____ _____
a manual) _____ _____

This is your mailing label. Please print the following information on it:

Name:

Address:

City/State/Zip:

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX87018
Date: October 14, 1987
APC: All

TO: Distribution

FROM: Ray Pettigrew

SUBJECT: All Mobile 1/4 Wave Antennas (see list)

Due to a supplier process problem, the neoprene rubber grommet (37-83391E02) used as the rod base insulator may be defective. Any parts shipped prior to August 1st could be defective. After August 1st, the grommet shipping is a 37-83391E01. It has a straight rod hole vs. the noticeably tapered hole of the suspect part 37-83391E02 grommet.

Two problems exist with the parts:

1. If rubber is soft, sticky, and permanently deformed when squeezed, it is bad.
2. If after a few weeks exposure to ultra violet rays from sunlight cracking occurs, it is bad.

Please check all stock now and return bad rod assemblies to C&E Parts for Warranty replacement. Specify the antenna concerned and associated rod assembly per the following list. Critical orders can be handled by phoning 1-800-422-4210.

This bulletin is for information and part replacement only. No labor authorization will be issued.

Regards,
Ray

/plw

MOBILE QUARTER - WAVE ANTENNAS

Roof, Magnet and Trunk Lip Mount

Antenna Model	Replacement Rod Assembly	Antenna Model	Replacement Rod Assembly
RRA4911A	01-83938B11	HAA4001A	01-83938B03
18	B11	HAD4006A	01-83938B01
19	B11	07	B02
RRA5308A	01-83938B01	08	B03
09	B02	09	B04
10	B03	10	B01
11	B04	12	B03
12	B01	HAE4002A	01-83938B05
13	B02	03	B06
14	B03	04	B08
15	B04	08	B08
RRA5548A	01-83938B05	HAF4000A	01-83938B11
49	B08	TAD6111A	01-83938B01
50	B06	12	B02
51	B08	13	B03
52	B05	14	B04
53	B07	15	B09
54	B06	TAE6051A	01-83938B05
55	B08	52	B06
		53	B07
		54	B08
		TAF6041A	01-83938B11

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

PSB #: TX87015
DATE: August 26, 1987
APC: All System 9000
DEADLINE: July 1, 1988

TO: DISTRIBUTION

FROM: PRODUCT SERVICES, FORT WORTH

SUBJECT: SYSTEM 9000 CONTROL HEAD POTENTIAL FRONT HOUSING FRACTURE PROBLEM

System 9000 control heads built between 2/1/87 and 5/15/87 may have the potential to experience some degree of weakening of the outer wall of the plastic front housing. This problem is a result of a chemical reaction between the housing and a temporary lubricant used to facilitate installation of the housing gasket.

While this type of fracturing would not immediately affect electronic functionality, it could jeopardize the environmental integrity of the control head.

Replacement front housings are available at no charge by ordering RPX Kit # 4736A from National Parts. Requests for quantities greater than 10 will require Product Service approval.

One half hour labor not to exceed $35 is authorized by referencing this service bulletin and the radio serial number on the warranty claim form. Multiple repairs can be claimed on a single warranty claim by referencing the applicable radio serial numbers.

The no charge RPX kit and labor reimbursement are available through 7-1-88.

Any problems or questions, please contact your local FTR support group.

Thank you,

Ft. Worth Product Services

/plw

PRODUCT SERVICES BULLETIN
FORT WORTH, TEXAS

OCT 29 1987

PSB # TX87013-A
October 26, 1987
APC: 246,463,483 &
Sys-9000E Trunked
Deadline: 6-30-88

TO: Distribution

FROM: Lee Webb

SUBJECT: TX87013-A Update

Syntor-X System 9000 Low Band, VHF, UHF, 800 MHz Conventional and System 9000E Trunked units can exhibit no TX deviation with heat due to a lock up condition which can occur on U300. This problem can be eliminated by installing a diode (P/N 48-82178A01) on the solder side of the personality board from U300 Pin 10 to Pin 12, cathode on Pin 12.

This bulletin authorizes up to a maximum of 1/2 hour or $35 maximum to an authorized Motorola Service Station for installing this upgrade. Further, it is recommended that this part be added on an "as required" basis only, because not all units will exhibit this problem. Units shipped after July 1987 will already have this upgrade added.

Any questions or problems, please contact your area engineering group.

Thank you,

Lee

Lee

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

PSB #: PSB TX87011
DATE: AUGUST 24, 1987
APC: 483, 621
(System 9000)

TO: DISTRIBUTION

FROM: LEE WEBB

SUBJECT: TX 86009 UPDATE, OSCILLATION OF DIGITAL AUDIO ATTENUATOR I.C.

As of the first of May, 1987, the Digital audio attenuator IC used in Syntor-X System 9000 units have a date code 8714 or above (reference P/N 51-83977M60). The Syntor-X 9000 Engineering Group recommends that only this date code be used for future replacements. The white dot parts talked about on PSB TX86009 were graded out devices and after date code 8714 the I.C. problem was corrected.

This bulletin has been issued as an analyzing aid only and no time can be charged against it. Any problems or questions, please contact your local FTR or Engineering group.

Regards,

Lee

Lee Webb

/plw

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

PSB #: TX87009
DATE: June 26, 1987
APC: 631
Syntor-X 9000 Trunked Only

TO: Distribution

FROM: Lee Webb

SUBJECT: Syntor-X 9000 Trunked Dropout Due to Inadequate Supply Voltage

The Syntor-X 9000 radio was designed such that the unit performs a self-check upon power up. This happens if radio power is interrupted, even momentarily.

Recently, this Product Service Department has investigated two customer complaints of loss of message, with self-check being displayed during the restart period. In these cases, both System 9000 Trunked units would reset when the vehicles' siren was switched on.

Case 1: Problem resolved by re-routing large black ground lead directly to vehicle chassis, thus insuring a good zero ohm ground.
Case 2: Problem resolved by re-routing the red A+ lead directly to the battery.

In both these cases, the radio and customer sirens shared a portion of the series path back to the battery. Thus when the high current load (siren) was switched in, the voltage drop across these shared paths increased and caused the supply at the radio to drop below the required minimum supply voltage. In both cases, the problem was momentarily occurring during the period of high current loading.

This bulletin has been issued as an analyzing/installation aid only and no time can be charged against this bulletin. Any problems or questions, please contact your local FTR or Engineering group.

Regards,

Lee

Lee Webb

/plw

PRODUCT SERVICES BULLETIN

FORT WORTH, TEXAS

MOBILE OPERATIONS PRODUCT SERVICES

PSB #: TX87001
DATE: 3-12-87
APC: 483,583,246,631,731
CUT OFF DATE: N/A

TO: DISTRIBUTION

FROM: LEE WEBB

SUBJECT: SYSTEM 9000 BUTTON LIST

I. TABLE #1 - Standard System 9000 control head buttons shipped prior to May 1987.

Table #1 - Standard Graphics Button List

PART NUMBER	GRAPHIC LEGEND
3SD80090J01	
J02	MPL
J03	Scan
J04	DVP
J05	PA
J06	Siren
J07	Wail
J08	Hi-Lo
J09	Man
J10	H/L
J11	Sts
J12	Call
J13	Msg
J14	Rcl
J15	Mode
J16	ExRd
J17	Del
J18	Sel
J19	Mon
J20	DTMF
J21	Yelp
J22	MVS
J23	Play
J24	Rply
J25	Rcrd
J26	Emer
J27	Ext
J28	F/R
J29	Alt
J30	Tel
J31	Sql
J32	DES
J33	Txt
J34	Indv
J35	Pvt
J36	Site
J37	AA
J38	Sub
J39	Home
J40	Menu
J41	Rcgm
J42	Sleb
J43	Phn
J44	Phone
J45	Dir
J46	Text
J47	Rvw
J48	Soc
J49	[illegible]
J50	L/S
J51	S/S
J52	Emer
J53	Stdy
J54	ECC
J55	Rptr
J56	State
J57	Reg
J58	AirHm
J59	TBScn
J60	SCC
J61	Srch
J62	Lock
J63	Page
J64	Rear
J65	Xfer
J66	ST
J67	VHF
J68	UHF
J69	Aux
J70	QC II
J71	Mute
J72	Pri
J73	Blu
J74	Div
J75	RTT
J76	Send
J77	Front

II. TABLE #2 - Bold graphic System 9000 control head buttons shipped on units after May 1987.

TABLE #2 - Bold Graphics Button List

PART NUMBER	GRAPHIC LEGEND
38D80043M01	
M02	MPL
M03	Scan
M04	DVP
M05	PA
M06	Siren
M07	Wail
M08	Hi-Lo
M09	Man
M10	H/L
M11	Std
M12	Call
M13	Msg
M14	Rcl
M15	Mode
M16	ExRc
M17	Del
M18	Sel
M19	Mon
M20	DTMF
M21	Yelp
M22	MVS
M23	Play
M24	Rely
M25	Rcrd
M26	Emer
M27	Ext
M28	F/R
M29	Alt
M30	Tel
M31	Sel
M32	DES
M33	Txt
M34	Indv
M35	Pvt
M36	Site
M37	AA
M38	Sub
M39	Home
M40	Menu
M41	Room
M42	Step
M43	
M44	Phon
M45	Dir
M46	Text
M47	Rvw
M48	Sec
M49	&
M50	L/S
M51	S/S
M52	Emer
M53	Stdy
M54	ECO
M55	Rotr
M56	State
M57	Reg
M58	AirHn
M59	TeSon
M60	SCO
M61	Scrn
M62	Lock
M63	Page
M64	Rear
M65	Xfer
M66	S-
M67	VHF
M68	UHF
M69	Aux
M70	CC II
M71	Mute
M72	Pri
M73	Blu
M74	Div
M75	Brt
M76	Send
M77	Front

III. TABLE #3 - Mode and volume rocker switch part no's.

TABLE #3 - Mode & Volume Rocker Button List

38D80091J07	STD GRAPHICS	▽ System △
38D80091J06	STD GRAPHICS	▽ Subfleet △
38D80091J05	STD GRAPHICS	▽ Zone △
38D80091J04	BOLD GRAPHICS	▽ Vol △
38D80091J03	BOLD GRAPHICS	▽ Mode △
38D80091J02	STD GRAPHICS	▽ Volume △
38D80091J01	STD GRAPHICS	▽ Mode △

IV. TABLE #4 - Direct entry keyboard button part no's.

Table #4 - DEK Button List

PART NUMBER	GRAPHIC LEGEND
38D80156L01	
L02	MSG 1
L03	MSG 2
L04	MSG 3
L05	MSG 4
L06	MSG 5
L07	MSG 6
L08	MSG 7
L09	MSG 8
L10	CODE 1
L11	CODE 2
L12	CODE 3
L13	CODE 4
L14	CODE 5
L15	CODE 6
L16	CODE 7
L17	CODE 8
L18	STS 1
L19	STS 2
L20	STS 3
L21	STS 4
L22	STS 5
L23	STS 6
L24	STS 7
L25	STS 8
L26	MODE 1
L27	MODE 2
L28	MODE 3
L29	MODE 4
L30	MODE 5
L31	MODE 6
L32	MODE 7
L33	MODE 8
L34	Siren
L35	PA
L36	Yelp
L37	Wail
L38	Hi-Lo
L39	Man
L40	ExRd
L41	ArHn

Aesthetic Note:

When replacing buttons on units built before May 1987, care must be taken not to mix standard and bold graphic buttons or it won't look right.

Thanks,

Lee

Lee Webb

/plw

PRODUCT SERVICES BULLETIN

PSB #: TX86013
Date: 10-6-86
APC: 483,621,6
System 92
Expiration Date: 1-1-87

To: Distribution

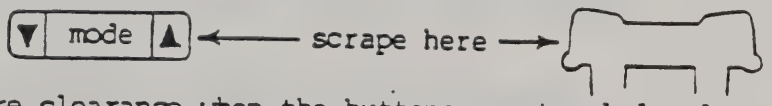
From: Bubba Chambers

Subject: Sticky Rocker Buttons on System 9000 Control Heads

The Syntor-X System 9000 Mechanical Engineering group has discovered through several phone inputs and a recent field trip by PSE personnel, a problem with the "Mode" and "Volume" rocker buttons sticking in the up or down position. This results in mode cycling continuously, or the volume running up to max or no audio at all. The cause was found to be in the front half of the control head housing. The openings for the mode and volume buttons may fall within the minimum tolerance. All units shipped prior to August 25, 1986 could possibly exhibit this problem.

An immediate resolution if this problem is discovered is:

1. Open control head by removing the 2 torx head screws located on the back side in the upper corners. Caution: use grounding strap.
2. Remove the display board from the front housing by taking out the 5 screws that hold it down.
3. Lay the front housing face down on a soft cloth to prevent scratching lens, and using a small screw driver or scribe, carefully pry the keyboard light pipe from the housing.
4. Remove the mode and rocker buttons and using a razor or xacto knife, carefully trim or scrape along the narrow ends of the buttons.

   Example: 

   This will allow more clearance when the buttons are toggled and prevent sticking.
5. Replace buttons and re-assemble control head.

An alternate solution would be to replace the front control head housing with a new re-tooled front housing available through National Parts and covered under the one year parts warranty. The changeout to a new front housing will consist of 4 parts to be ordered:

1. Front housing, 15-08088J01
2. VF (display) lens, 61-80095J01
3. Lens gasket, 32-80057K01
4. Escutcheon, 13-80087J01

The replacement will involve disassembly and removal of all buttons from old housing and reinstalling into new one.

Note: This bulletin is being issued as a service aid only.

Any problems or questions, contact your local Field Technical Representative.

Thank You,

Bubba Chambers

Bubba Chambers
Product Service Engineering

PRODUCT SERVICES BULLETIN

PSB #: TX86012
Date: 10-6-86
APC: 483,621,631
System 9000

To: Distribution

From: Bubba Chambers

Subject: Siren Transient/Lock-Up Problems on System 9000 Radios

The Syntor-X System 9000 Trunked Engineering group has discovered through PSE & Field inputs, transient and/or lock-up problems in the operation of the Systems 9000 Siren units. Symptoms that relate to this type of problem are listed below.

1. Siren operates, but siren functions fail to display on the control head.
2. Siren and PA lights come on, on the control head, but unit is inoperable.
3. Siren/PA completely fails to operate and buttons do not function either.

Should the above symptoms be observed, the following steps will help determine the cause and corrective action needed to isolate the problem.

1. To determine if the trouble is software related:
   A. Turn the radio off and then back on, at the control head, unit will cycle "self check" and reset; check the siren functions again.
   B. If the above step does not clear the problem, next, turn the control head off, disconnect A+ both from radio and siren amp at the cable fuse kits. Note: do not unplug any of the power cables at radio on siren amp plugs!

Solution:

Should any of the steps listed above clear the problems, more than likely a software change and/or upgrade is required. Open the siren amp by removing the 4 screws that hold the cover on. Next remove the software, which is located at U7 on the circuit board. Verify the label to read 0180743T34, this is version 1.00. Replace with software version 1.01, 0180746T02 available through National Parts Dept.

2. If the procedures in Step 1 do not clear problems, check for intermittent cable connection and/or cables by:

   A. Turn radio off at control head, disconnect the power cable at the siren amp, inspect the cable connector for damaged or crushed pins, straighten or repair any damaged pins and reconnect cable securely being careful not to redamage any of the pins. Recheck for proper siren operation.
   B. Next, repeat this same procedure at the "T" connector end of the power cable.

Solution:

If any of the procedures under Step 2 clear the problem but continues to intermittently fail, the siren/PA cable should be replaced. Use HKN4244A for Trunked radios, and HKN4246A for Conventional radios.

Note: This bulletin is being issued as a service aid only.

Any problems or questions, please contact your local Field Technical Representative.

Thank You,

Bubba Chambers

Bubba Chambers
Product Service Engineering

/plw

PRODUCT SERVICES BULLETIN

PSB #: TX86009
Date: 8-29-86
APC: 483, 621
(System 9000)

To: Distribution

From: Bubba Chambers

Subject: Oscillation of Audio Attenuator I.C. in Syntor-X Systems 9000

The Syntor-X, Systems 9000 Engineering group has discovered a problem in the Digital Audio Attenuator I.C. (P/N 51-83977M60). This IC is used in three different kits. Their location and problem symptoms are:

1. Location: U5, Systems 9000 Siren, Kit # HLN4897A/4917A, PA Board
   Symptom: Distorted PA audio

2. Location: U6, Systems 9000 Trunked Control Head, Kit # HLN4896B
   Symptoms: Distorted audio, hissing and popping in audio

3. Location: U302, Systems 9000 Conv. Person. Board, Kit # HLN4896A/B/C
   Symptoms: Distorted audio, hissing and popping in audio, squelch unmutes and will not stay muted.

Should these symptoms be noted, a spectrum analyzer or an oscilloscope can be used to verify if oscillation is present on the output pin (pin 14) or the power supply pin (pin 11) of the devices. During verification, if oscillation is not immediately present, use a heat gun or a hot iron on the device to check for the above mentioned symptoms. Defective I.C.'s should be replaced with new graded out ones that can be identified by a white dot on the top side. These I.C.'s may be obtained through National Parts Department.

Note: This bulletin is a service aid only and there will be no authorizations issued outside of standard warranty.

Any problems or questions, please contact your local Field Technical Representative.

Thank You,

Bubba Chambers
Product Service Engineering

/plw

PRODUCT SERVICES BULLETIN

PSB # TX86006
DATE: 4-22-86
APC: 246, 483, 621, 631

TO: Distribtuion

FROM: Bubba Chambers

SUBJECT: System 9000 Control Head Display

The Syntor-X Engineering group has determined that there is a potential problem with intermittent loss of, or no dislplay on the Systems 9000 control heads manufactured and shipped prior to March 1, 1986. The control heads still function properly, although you are unable to determine which mode you are in with the display being blanked.

This problem is corrected by touching up, or reheating the solder contacts of the "T1" conversion voltage transformer located on the controller board inside the control head. It would be to your advantage that during any service intervals or repairs, you go ahead and perform this as a preventative maintenance to avoid any future returns of the unit for this problem.

The kits effectived are the HLN4907A controller board (conventional control head) and the HLN4896A (trunking control head).

Note: This bulletin is being issued as a service aid only and there will be no warranty time auuthorized.

Any problems or questions, please call Product Services, Ft. Worth, TX (817)232-6389 or Ditel 729-6389.

Regards,

Bubba Chambers

Bubba Chambers

/plw

PRODUCT SERVICES BULLETIN

PSB # TX86001
DATE: 4-22-86
APC: All System 9000

TO: Distribtuion

FROM: Lee Webb

SUBJECT: System 9000 Incompatibilities

All Syntor-X 9000 radios (trunked, conventional and securenet) are incompatible with all existing benon cables which can be connected to the front of a Syntor-X radio.

This incompatibility includes existing universal control panels both the RCC1000A and TEK-25 series. The system 9000 radio should only be connected to Syntor-X 9000 cable kits.

FAILURE TO FOLLOW THIS PROCEDURE WILL CAUSE RADIO FAILURES
(I.E. ELECTRICAL DAMAGE WILL OCCUR)

System 9000 radios shipped after March 1986 will have the following top cover label:

> Caution
> Connect radio only to Syntor-X 9000 cable kits. Connection to other cable kits or control panels will cause electrical damage.

Any problems or questions, please call Product Services, Ft. Worth, TX (817)232-6242 or Ditel 729-6242.

Regards,

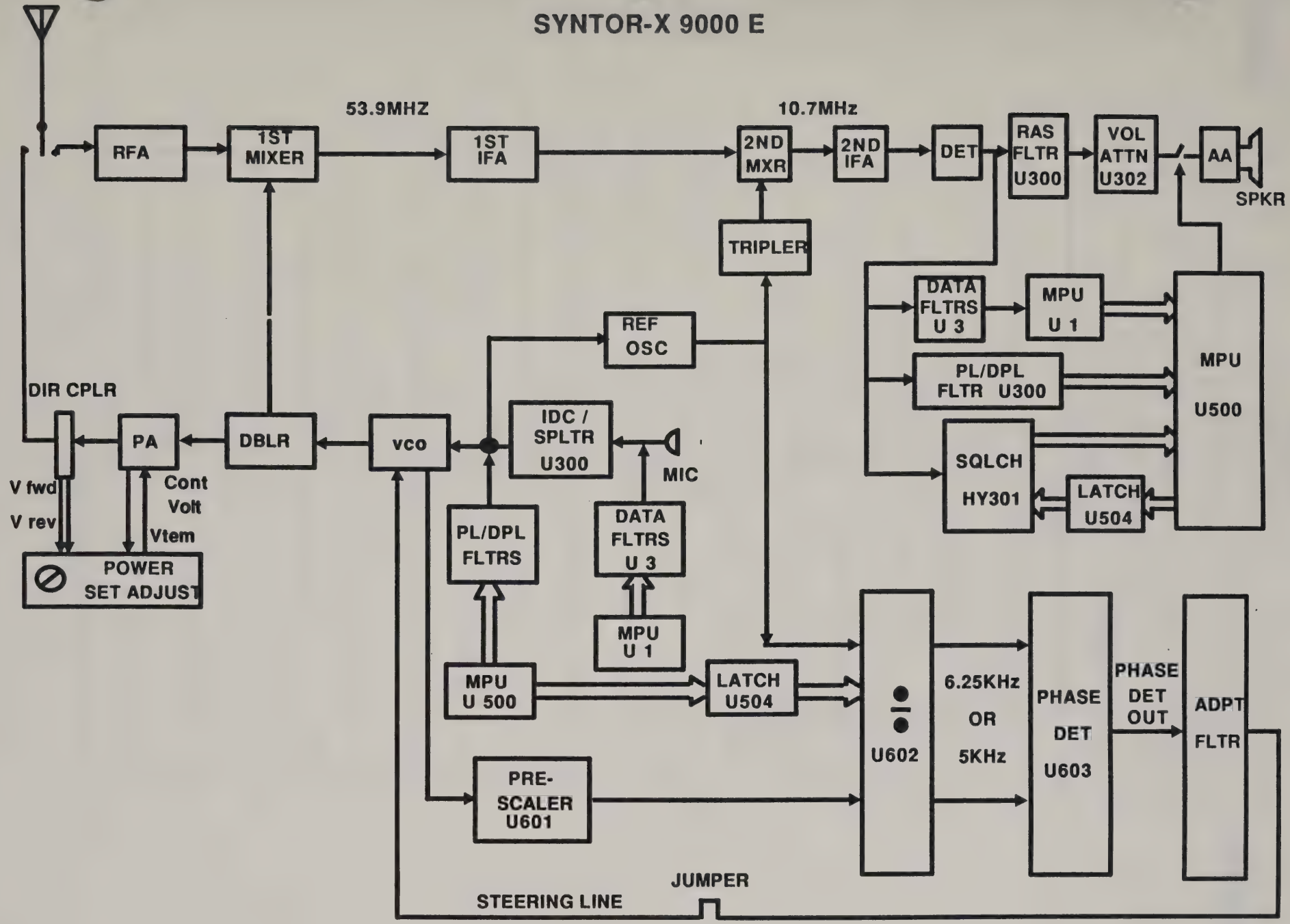
Lee

Lee Webb

/plw

SIMPLIFIED DIAGRAMS and TROUBLESHOOTING INFORMATION

SYNTOR-X 9000 E

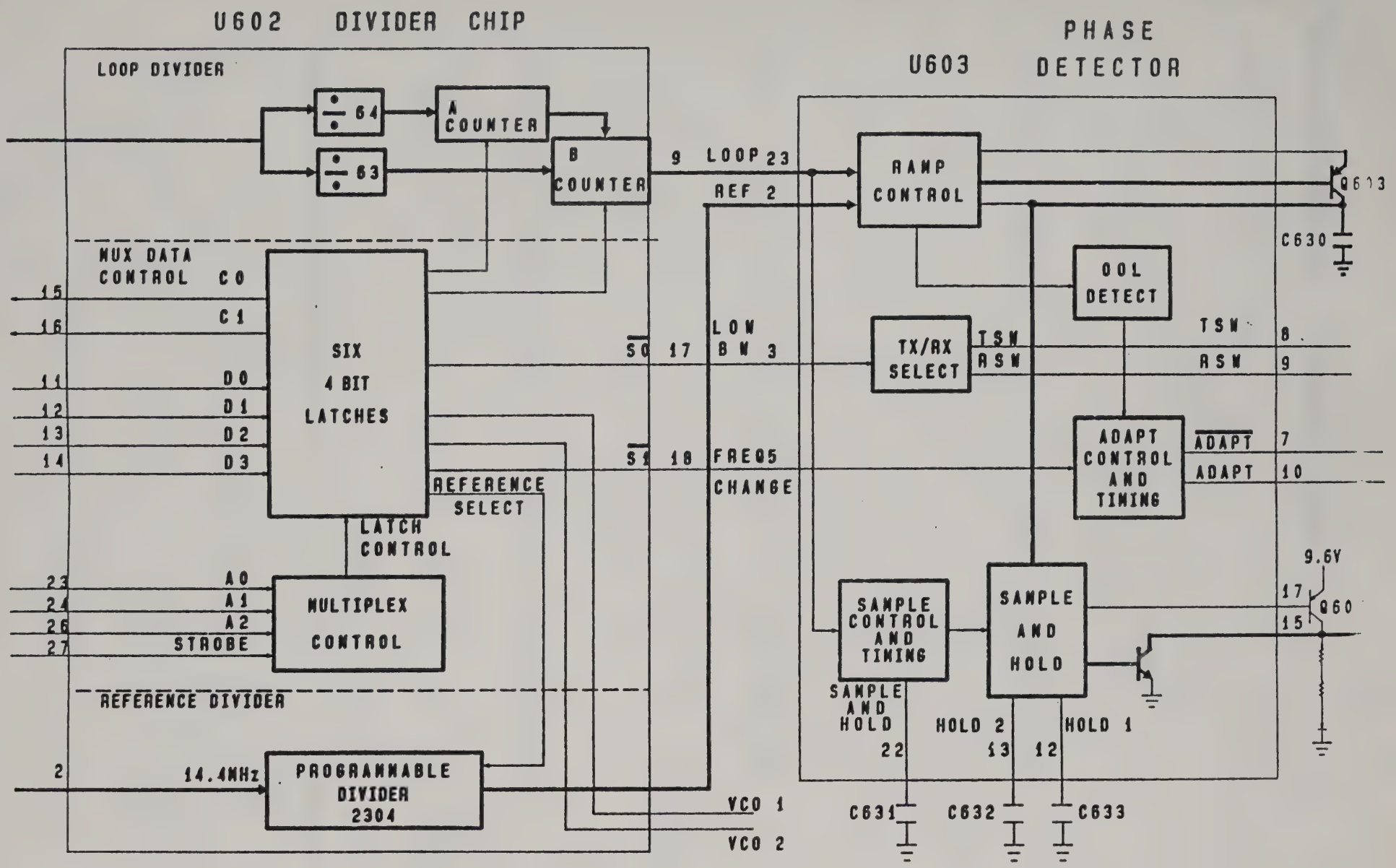


RADIO

OPTION

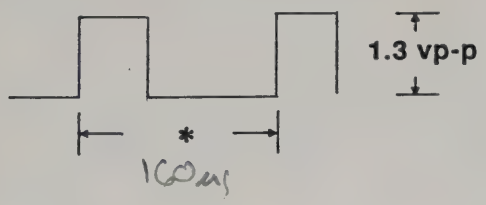
J301/P301
Connections

J301		P301
1	BUSY	20
2	$\overline{\text{TX DATA}}$	18
3	SW 5v	16
4	UNSW 5v	14
5	Digital Gnd	12
6	Aud Gnd	10
7	9.6VDC	8
8	VAG	6
9	Detected Audio	4
10	Rx Audio	2
11	Mic Hi	1
12	Tx Audio	3
13	CD STO	5
14	FLT Audio	7
15	PA Enable	9
16	$\overline{\text{WE}}$	11
17	KID	13
18	KEY	15
19	RESET	17
20	RX DATA	19

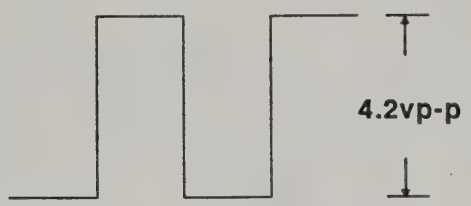

U602 DIVIDER CHIP
LOOP DIVIDER
÷ 64
÷ 63
A COUNTER
B COUNTER
MUX DATA CONTROL
C0
C1
D0
D1
D2
D3
SIX 4 BIT LATCHES
LATCH CONTROL
REFERENCE SELECT
A0
A1
A2
STROBE
MULTIPLEX CONTROL
REFERENCE DIVIDER
14.4MHz
PROGRAMMABLE DIVIDER 2304
9 LOOP 23
REF 2
S0 17
LOW BW 3
S1 18
FREQS CHANGE
VCO 1
VCO 2
PHASE DETECTOR
U603
RAMP CONTROL
Q613
C630
OOL DETECT
TX/RX SELECT
TSW
RSW
TSW 8
RSW 9
ADAPT CONTROL AND TIMING
ADAPT 7
ADAPT 10
9.6V
SAMPLE CONTROL AND TIMING
SAMPLE AND HOLD
Q60
17
15
SAMPLE AND HOLD 22
HOLD 2 13
HOLD 1 12
C631
C632
C633

Phase Detector : Waveforms

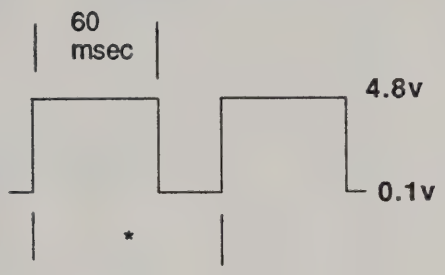
U602-9 TP: 62 Loop Output



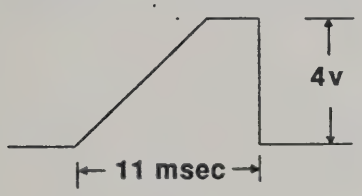
U603-2 TP: 64 Reference



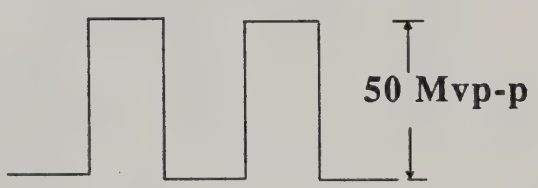
U603-4 TP: 66 Synth Sync



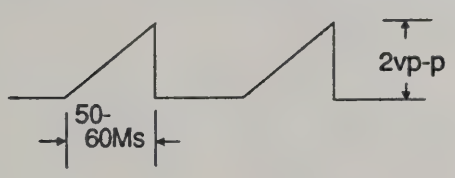
U603-5 TP: 63 Frequency Change Pulse



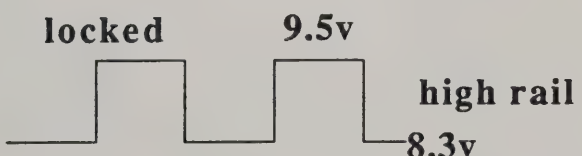
Pin 19 TP: 67 Ramp Base



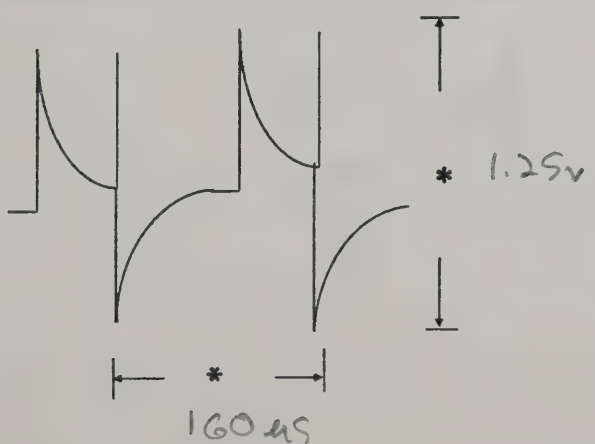
U603-22 TP: 69 Sample Timing Cap

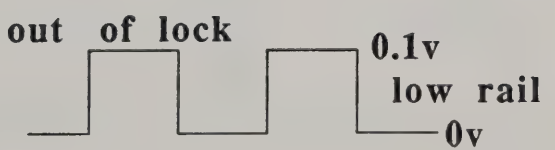


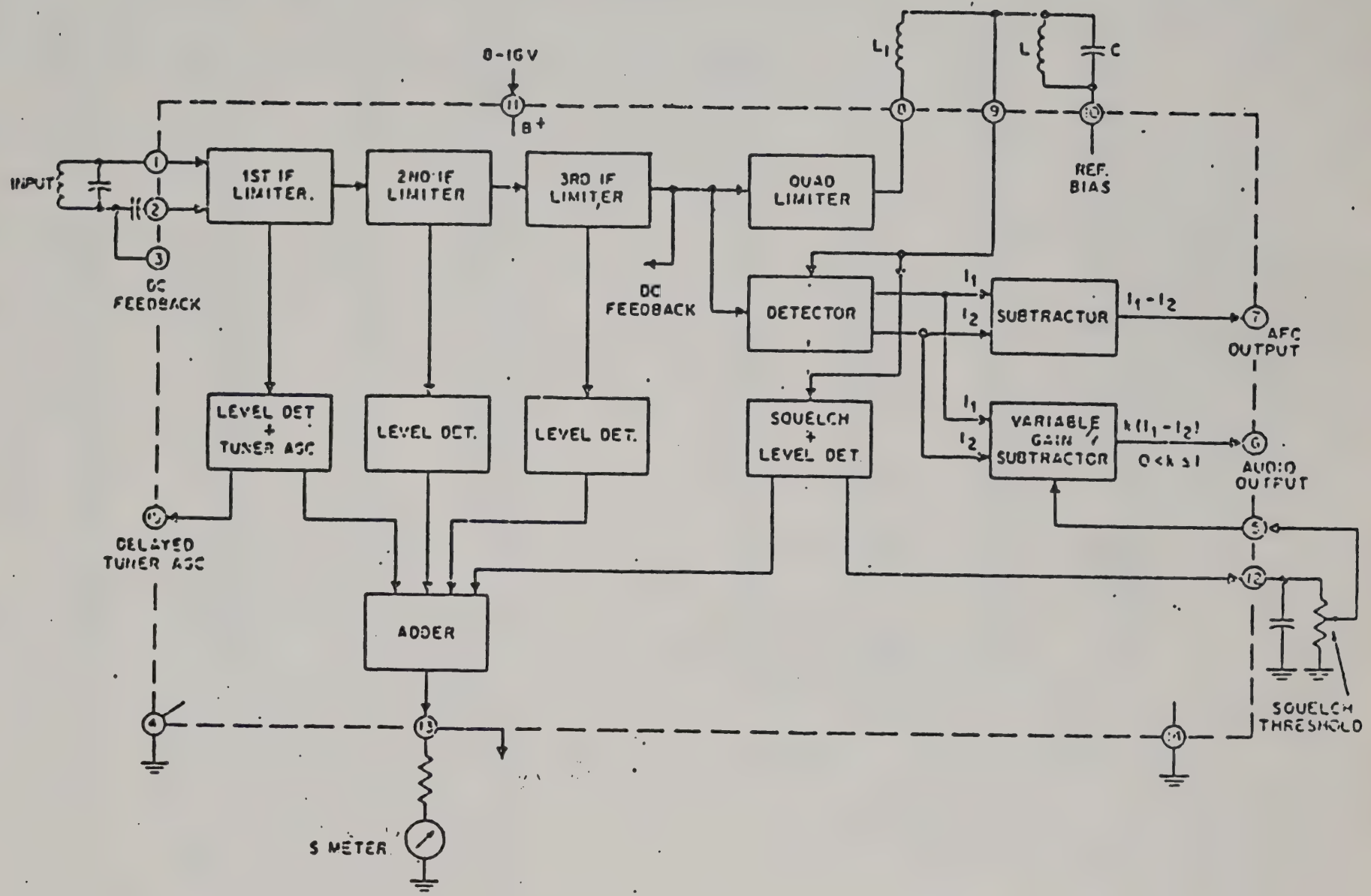
Pin 24 TP: 68 Ramp Capacitor



U603-23 TP: 65 Loop Input to Phase Det





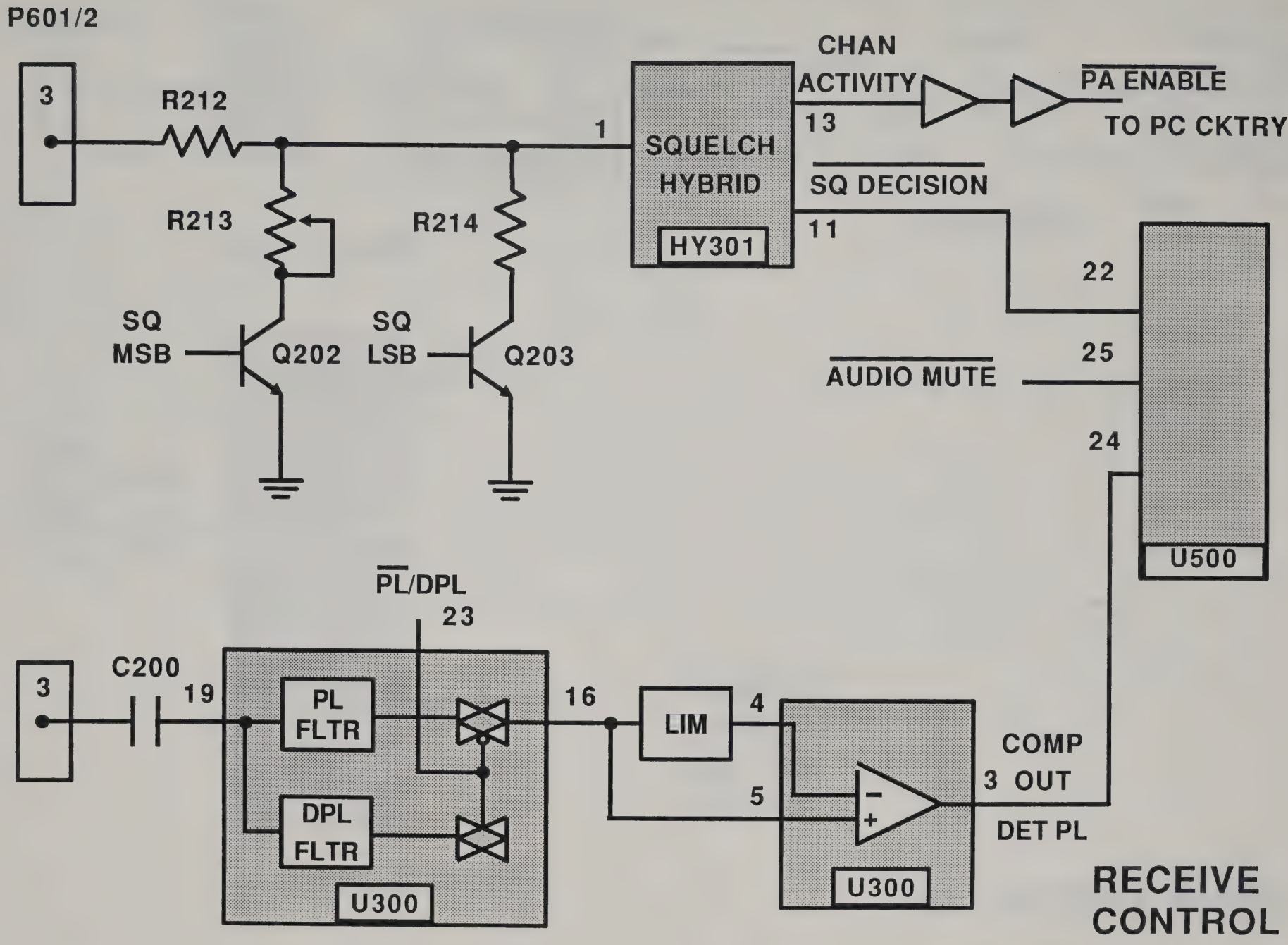

0-16V
B+
L1
L
C
INPUT
1ST IF LIMITER.
2ND IF LIMITER
3RD IF LIMITER
QUAD LIMITER
REF. BIAS
DC FEEDBACK
DC FEEDBACK
DETECTOR
SUBTRACTUR
AFC OUTPUT
LEVEL DET + TUNER AGC
LEVEL DET.
LEVEL DET.
SQUELCH + LEVEL DET
VARIABLE GAIN SUBTRACTOR
AUDIO OUTPUT
DELAYED TUNER AGC
ADDER
S METER
SQUELCH THRESHOLD

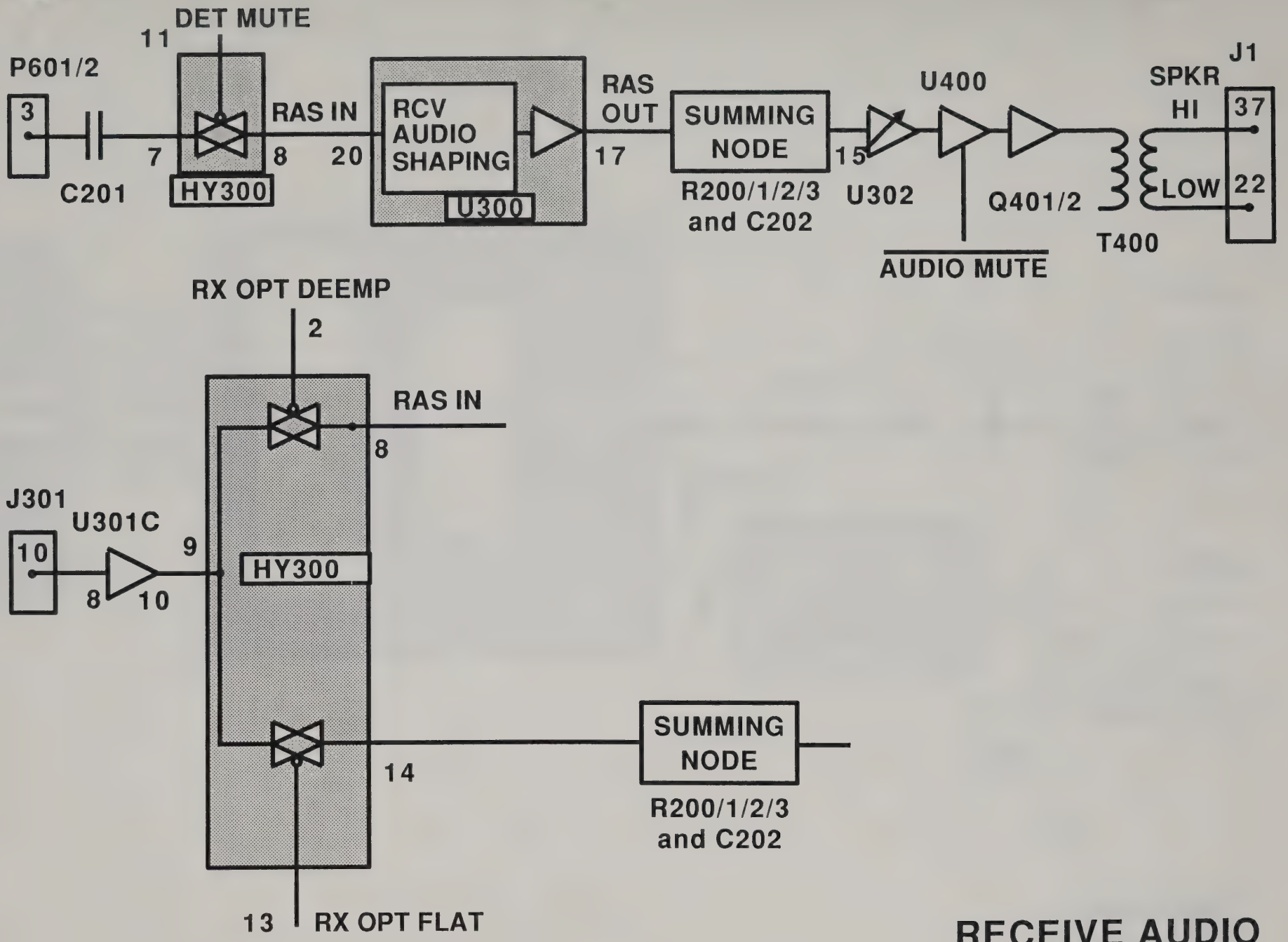
PRIVATE-LINE Codes

CODE	HZ	CODE	HZ
XZ	67.0	3B	131.8
WZ	69.3	4Z	136.5
XA	71.9	4A	141.3
WA	74.4	4B	146.2
XB	77.0	5Z	151.4
WB	79.7	5A	156.7
YZ	82.5	5B	162.2
YA	85.4	6Z	167.9
YB	88.5	6A	173.8
ZZ	91.5	6B	179.9
ZA	94.8	7Z	186.2
ZB	97.4	7A	192.8
1Z	100.0	M1	203.5
1A	103.5	8Z	206.5
1B	107.2	M2	210.7
2Z	110.9	M3	218.1
2A	114.8	M4	225.7
2B	118.8		
3Z	123.0		
3A	127.3		

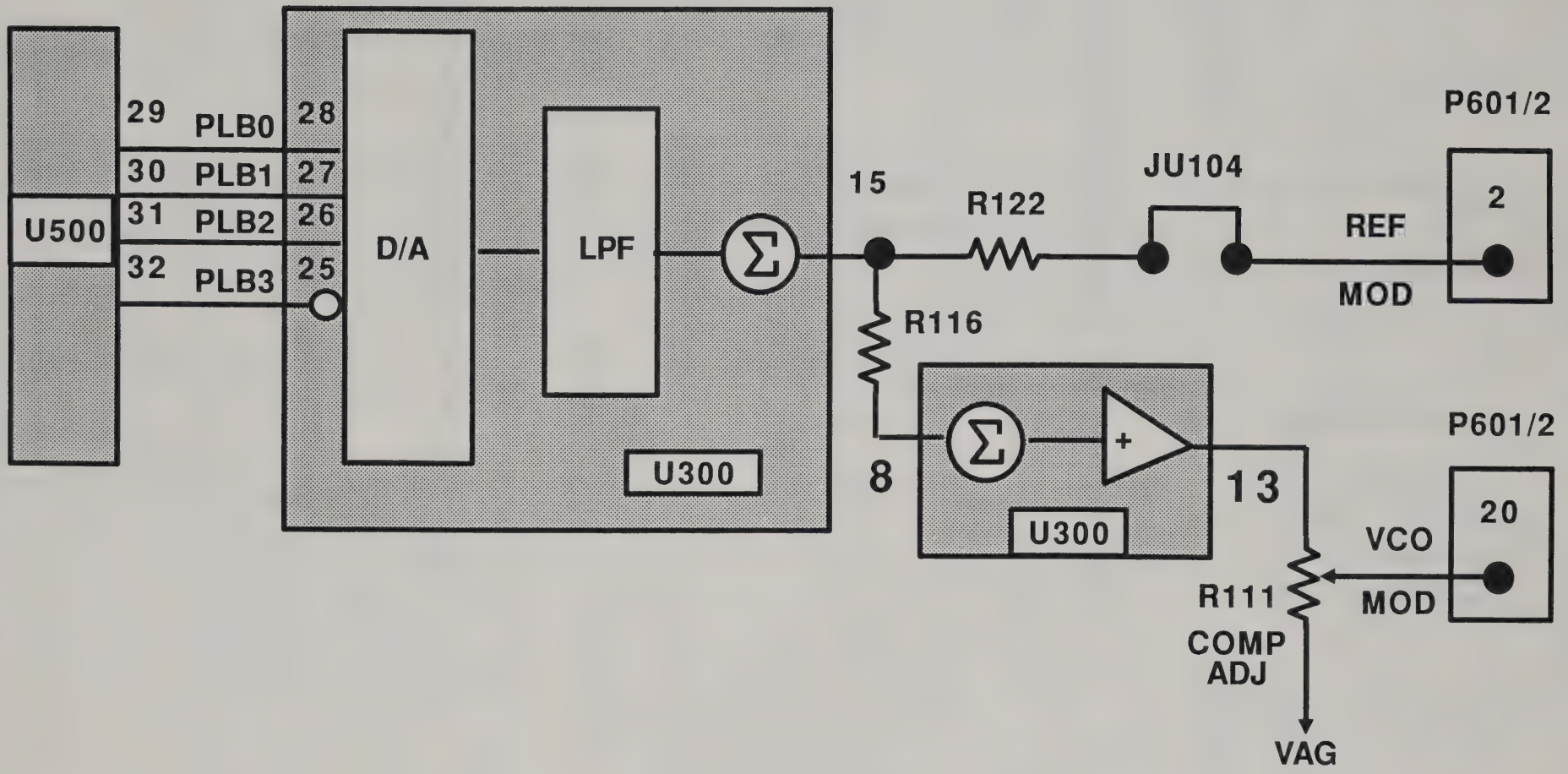
DIGITAL PRIVATE-LINE Codes

023	143	315	532
025	152	331	546
026	155	343	565
031	156	346	606
032	162	351	612
043	165	364	624
047	172	365	627
051	174	371	631
054	205	411	632
065	223	412	654
071	226	413	662
072	243	423	664
073	244	431	703
074	245	432	712
114	251	445	723
115	261	464	731
116	263	465	732
125	265	466	734
131	271	503	743
132	306	506	754
134	311	516	


P601/2
3
R212
1
SQUELCH
HYBRID
HY301
CHAN
ACTIVITY
13
PA ENABLE
TO PC CKTRY
SQ DECISION
11
R213
R214
SQ
MSB
Q202
SQ
LSB
Q203
22
25
AUDIO MUTE
24
U500
PL/DPL
23
3
C200
19
PL
FLTR
DPL
FLTR
U300
16
LIM
4
5
COMP
3 OUT
DET PL
U300
RECEIVE
CONTROL

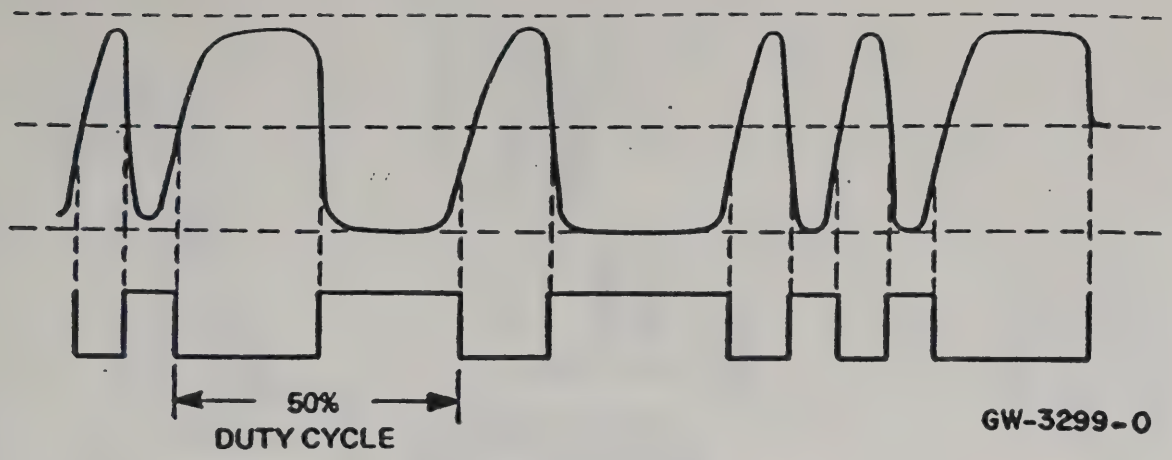


RECEIVE AUDIO

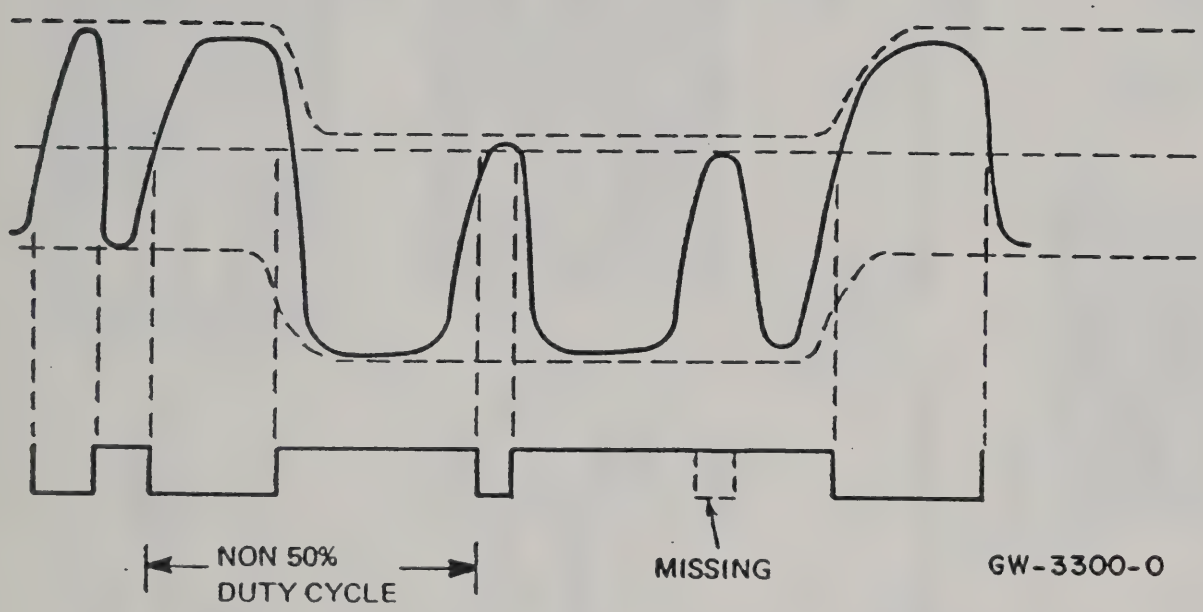


TRANSMIT CONTROL

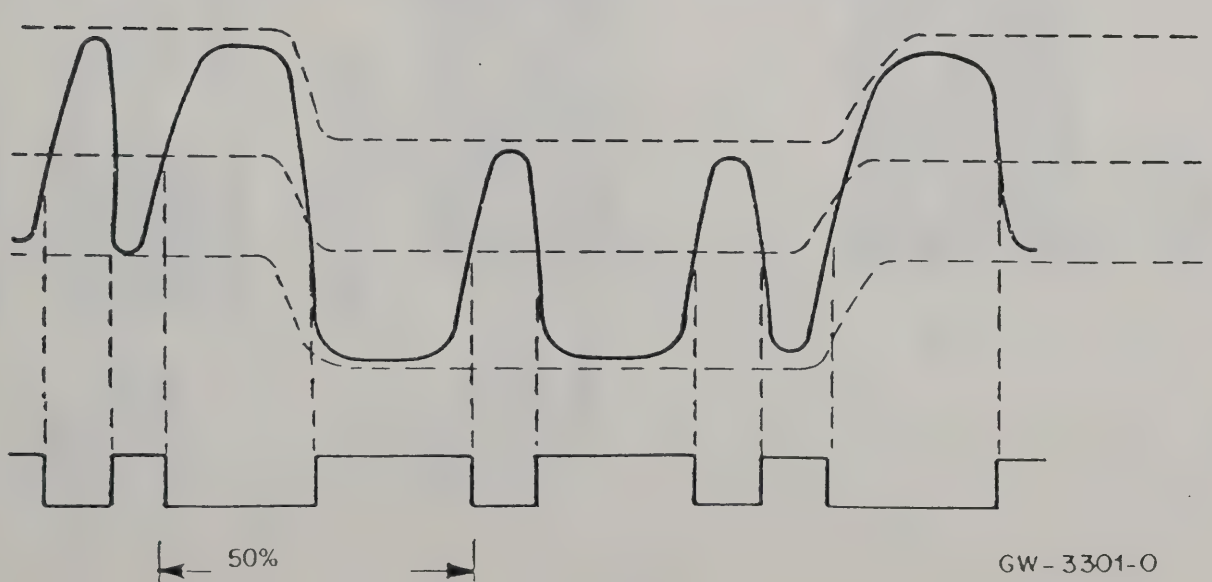
A. GOOD DATA (NO DC OFFSET)

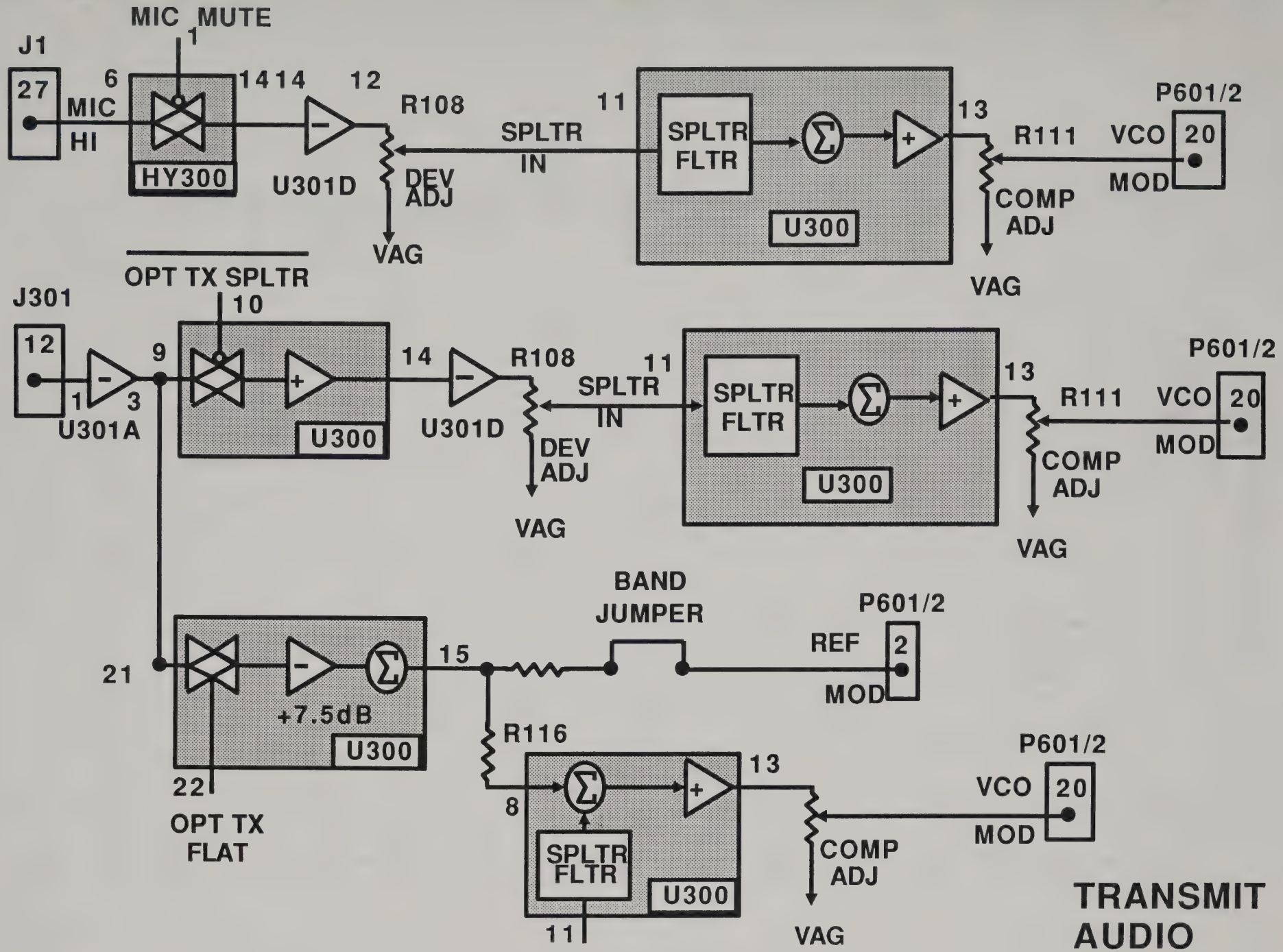


B. BAD DATA (WITH DC OFFSET) NO CENTERSLICER

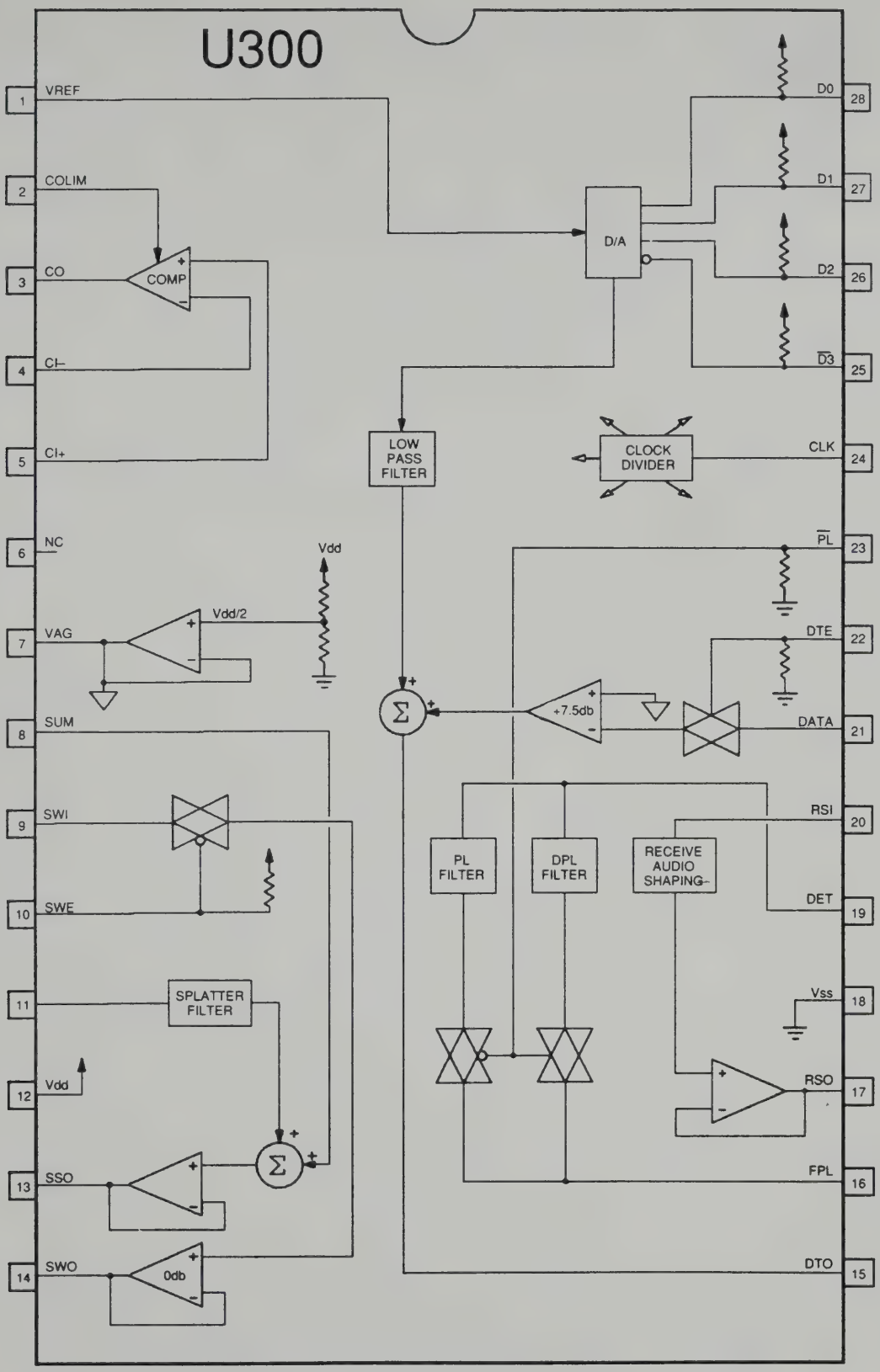


C. GOOD DATA (WITH DC OFFSET) WITH CENTERSLICER




MIC MUTE
1
J1
27
6
MIC
HI
HY300
1414
12
U301D
R108
DEV
ADJ
VAG
SPLTR
IN
11
SPLTR
FLTR
U300
13
R111
COMP
ADJ
VAG
P601/2
VCO
20
MOD
OPT TX SPLTR
10
J301
12
1
3
U301A
9
14
U300
U301D
R108
DEV
ADJ
VAG
SPLTR
IN
11
SPLTR
FLTR
U300
13
R111
COMP
ADJ
VAG
P601/2
VCO
20
MOD
21
+7.5dB
U300
22
OPT TX
FLAT
15
BAND
JUMPER
P601/2
REF
2
MOD
R116
8
SPLTR
FLTR
U300
11
13
COMP
ADJ
VAG
P601/2
VCO
20
MOD
TRANSMIT
AUDIO

U300 BLOCK DIAGRAM



GPW–2585–A

U300 Functional
Block Diagram
PW–4552–A
8/30/88

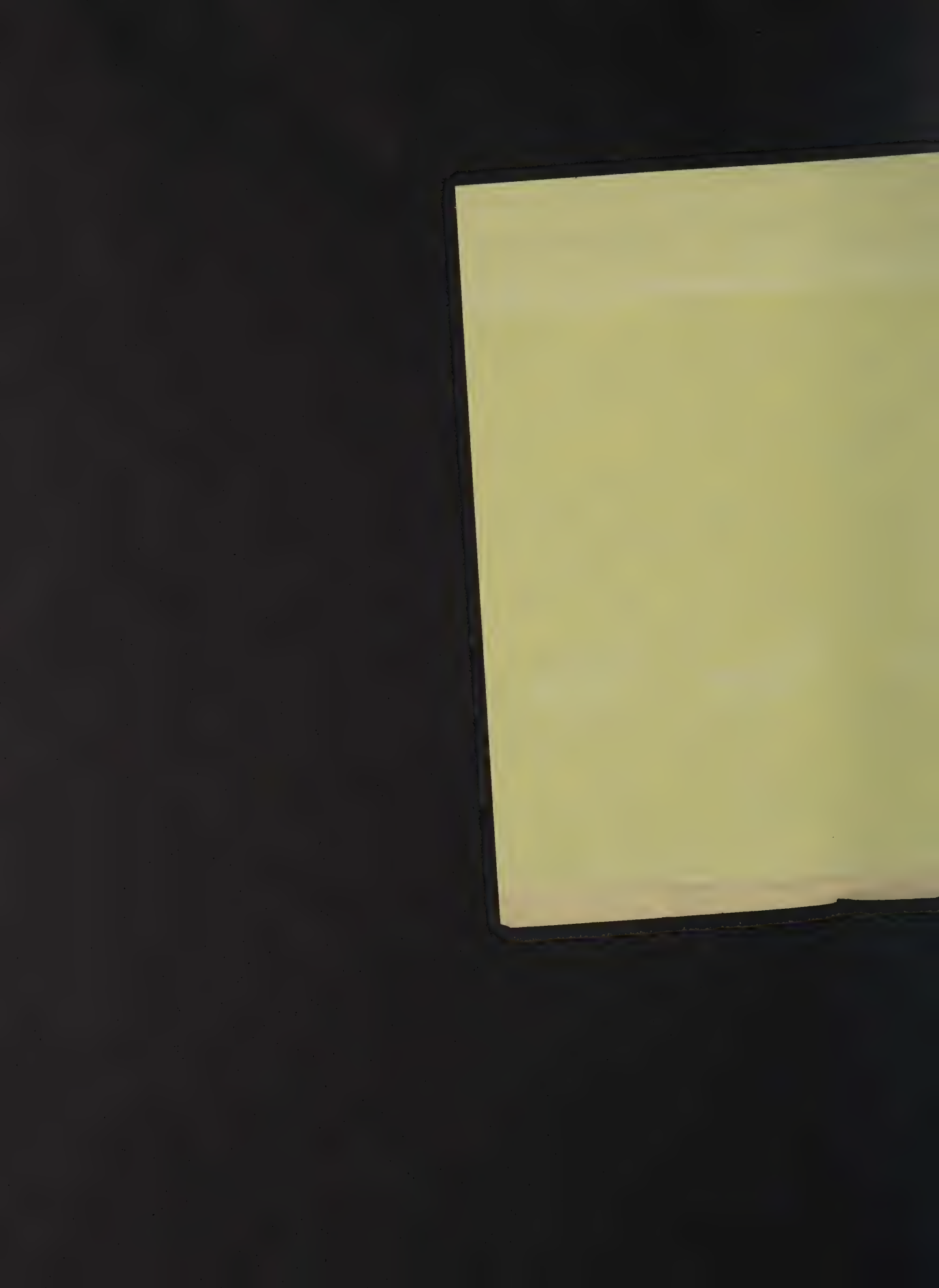
MOTOROLA

National Service
Training Center

1300 N. Plum Grove Road
Schaumburg, IL 60195
(312) 576-2079

SYNTOR X 9000 OPTIONS

1.	FULL FEATURED SECURENET	68P80101W56
2.	SYSTEMS 9000 SECURITY HOUSING	68P80101W75
3.	BASIC SECURENET	68P80100W97
4.	SIREN/PA	68P80101W10
5.	BASIC MDC 600	68P80101W08
6.	MOBILE VOICE STORAGE	68P80100W98
7.	DIRECT ENTRY KEYBOARD	68P80101W22
8.	DTMF	68P80101W21
9.	MDC 600	68P80101W15



SYSTEM - 9000(CONVENTIONAL) ERROR DISPLAYS

"ERROR 01/10"

```
        |  |
        |  |======> HEXADECIMAL CODE FOR TYPE OF ERROR
        |
        |=========> ADDRESS OF SYSTEM UNIT WITH ERROR
```

ADDRESS ASSIGNMENTS:

ADDRESS	UNIT
01	RADIO
05	CONTROL HEAD
08	SIREN/P.A.
09	BASIC SECURENET
0A	MDC STATUS/MESSAGE/SELECT CALL
0D	MOBILE VOICE STORAGE
0E	DTMF
0F	TTMF
10	TRUNKING

ERROR CODE:

****NOTE: A BIT SET IN ANY POSITION INDICATES A FAILURE.**

BIT 0 - ROM FAILURE
BIT 1 - EEPROM FAILURE
BIT 2 - EEPROM IS BLANK
BIT 3 - RAM FAILURE
BIT 4 - HARDWARE FAILURE
BIT 5 - SERIAL BUS ERROR
BIT 6 - KEYPAD LOCKED (USED FOR PORTABLE APPLICATIONS)
BIT 7 - FATAL ERROR; IF THIS BIT IS SET THE SYSTEM WILL LOCK UP UNTIL THE FAILURE IS CORRECTED. "FAIL" WILL BE DISPLAYED INSTEAD OF "ERROR".

EXAMPLES:

"ERROR 09/10" - BASIC SECURENET HAS A HARDWARE FAILURE

HEXIDECIMAL #	1	0
BINARY CONVERSION	0001	0000
	||||	||||
BITS	7654	3210

"FAIL 01/84" - RADIO EEPROM IS BLANK

"ERROR 0D/10" - MVS HAS A HARDWARE FAILURE

TROUBLESHOOTING GUIDE FOR CONVENTIONAL SYSTEMS 9000 SYNTOR X

TABLE OF CONTENTS

1) SCOPE OF GUIDE

2) EQUIPMENT REQUIREMENTS

3) KNOWN PROBLEMS

4) ERROR CODE TABLE

5) PERSONALITY BOARD DIGITAL TROUBLESHOOTING

6) SYSTEMS 9000 METERING POINTS

1) SCOPE OF TROUBLESHOOTING GUIDE

THE INTENTION OF THIS GUIDE IS TO FAMILIARIZE THE FIELD TECHNICIAN WITH THE CIRCUITRY UNIQUE TO THE SYNTOR X 9000 RADIO. THE RF CIRCUITRY (SYNTHESIZER, RF POWER AMP, POWER CONTROL, AND RECEIVER)IS THE SAME AS THE SYNTOR X SYSTEMS 90 RADIO AND IS NOT COVERED.

TYPICAL PROBLEMS ARE COVERED WITH THE EMPHASIS PLACED ON SYMPTOMS OF THE PROBLEM TO QUICKLY IDENTIFY THE PROBLEM'S CAUSE AND CURE.

ERROR CODES APPEARING ON THE CONTROL UNIT DISPLAY ARE EXPLAINED IN ANOTHER SECTION TO HELP THE TECHNICIAN GET AT THE PROBLEM.

2) EQUIPMENT REQUIREMENTS

THE FOLLOWING LIST OF EQUIPMENT IS DESIRABLE TO AID IN TROUBLESHOOTING THE SYNTOR X 9000 UNIQUE CIRCUITRY:

A) HIGH CURRENT POWER SUPPLY (CAPABLE OF 30 AMPS)

B) DUAL TRACE OSCILLOSCOPE (MINIMIUM 10MHZ BANDWIDTH)

C) HIGH IMPEDANCE DIGITAL MULTIMETER (ACVOLTS,DCVOLTS,OHMS AND DIODE TEST)

D) SPARE CABLE KIT FOR BENCH USE (HKN4241A OR HKN4256A)

E) SPARE CONTROL HEAD (OPTIONAL, CUSTOMER UNIT MAY BE REMOVED EASILY FOR BENCH WORK)

E) 50 OHM POWER LOAD (CAPABLE OF 150 WATTS)

F) 8 OHM LOAD WITH SPEAKER (1 SIDE OF SPEAKER MUST BE GROUNDED TO INSTRUMENT GROUND)

3) KNOWN PROBLEMS

A) RAM LOSS DUE TO VEHICLE STARTER CRANKING
B) RFI FROM ANTENNA TO RADIO OR CONTROL HEAD
C) NO RF POWER OUT (Q511)
D) NO RECEIVE OR TRANSMIT AUDIO (Y300 OSCILLATOR)
E) NO MICROPHONE DEVIATION (1% R'S SHORTING)
F) SQUELCH TAIL NOISE BURST WHEN DEKEYING MICROPHONE
G) NO CONTROL HEAD DISPLAY (T1 LEAD CONTAMINATION)
H) "A" SUFFIX CONTROL HEAD DISPLAY PROBLEMS
I) AUDIO POPPING DURING SCAN OR MODE CHANGING (U302)
J) INTERMITTENT OR NO SPEAKER AUDIO (HEAT SINK SHORTING)
K) RADIO AND SIREN SYSTEM LOCKING UP
(NO CONTROL HEAD DISPLAY OR FUNCTION)
L) RADIO OR CONTROL HEAD THAT REQUIRES EEPROM REPROGRAMMING

A) RAM LOSS DUE TO VEHICLE STARTER CRANKING

RAM LOSS IS DEFINED AS RESETTING THE RADIO TO DEFAULT VALUES DURING ENGINE CRANKING, OR WHEN A VEHICLE ACCESSORY IS SWITCHED OFF OR ON. THE USER SELECTABLE PARAMETERS ARE:

MODE NUMBER
VOLUME SETTING
SQUELCH SETTING
OPERATOR SELECTED SCAN LIST
OPERATOR SELECTED MPL SETTING
DIRECT ON/OFF

OPTIONS IN THE RADIO CAN LOSE RAM VALUES ALSO. THESE VALUES ARE:

SECURENET ON/OFF
BASIC SECURENET DUAL CODE SELECTION
MDC600 UNIT/GROUP/FLEET SELECTION
MDC600 LAST STATUS SENT
MDC600 LAST MESSAGE SENT
SIREN/PA PA VOLUME
SIREN/PA SIREN TONE TYPE (SIREN WILL RESET TO OFF)
DTMF/PHONE DTMF REDIAL NUMBER (SCRATCH PAD)
DTMF/PHONE PHONE REDIAL NUMBER (SCRATCH PAD)

THIS PROBLEM HAS BEEN NOTICED IN THE FIELD, AND NEARLY ALL OF THE PROBLEM VEHICLES HAVE BEEN LATE MODEL FORD LTD'S. THIS IS THE FIRST CLUE IF A RADIO IS CAUSING PROBLEMS.

THE SOLUTION TO RAM LOSS IS TO FIRST INSPECT THE VEHICLE'S BATTERY, CABLES, GROUNDING TO THE ENGINE BLOCK/CHASSIS AND THE RADIO'S GROUND, RED LEAD, AND GREEN LEADS. CORROSION ON ANY OF THESE CONNECTIONS WILL CAUSE THE BATTERY DROP DURING ENGINE CRANKING TO BE MUCH MORE THAN IF THE CONNECTIONS WERE IN GOOD CONDITION.

IF THESE CONNECTIONS ALL ARE IN GOOD CONDITION THE NEXT STEP IS TO ADD A DIODE PN 4880008E01 TO THE PERSONALITY BOARD ON THE SOLDER SIDE OF THE RF BOARD CONNECTOR (P601/602). THE ANODE OF THE DIODE SHOULD BE SOLDERED TO PIN 18 AND THE CATHODE SHOULD BE SOLDERED TO PIN 19. THIS WILL PULL THE 9.6 VOLT SUPPLY DOWN WITH SWB+ AND TRIGGER THE NMI (U500 PIN 8) SIGNAL MUCH FASTER.

THE PARTS Q516,Q517,R942-R947 SHOULD BE INSPECTED ALSO BECAUSE THE ADDITION OF THE DIODE WILL NOT HELP IF THIS CIRCUIT IS NOT FUNCTIONING.

B) RFI FROM ANTENNA TO RADIO OR CONTROL HEAD

SOME INSTALLATIONS HAVE CREATED A SELF RF INTERFERENCE WITH THE SYSTEMS 9000 RADIO. THE SYMPTOMS CAN BE:

BUZZING IN THE SPEAKER WHEN TRANSMITTER IS KEYED
RADIO RESETS WHEN KEYED (SELF CHECK ON DISPLAY)
SYNTHESIZER JUMPS IN AND OUT OF LOCK WHEN XMITTER IS KEYED

TO DETERMINE IF THE PROBLEM IS RF INTERFERENCE, FIRST CONNECT THE RADIO TO A 50 OHM DUMMY LOAD AND SEE IF THE PROBLEM GOES AWAY.

THE FIRST PROBLEMS TO LOOK FOR ARE:

POOR RADIO GROUND (BLACK LEAD)
ANTENNA LEAD TOO CLOSE TO RADIO CABLE KIT
POOR A+ CONNECTION
ANTENNA TOO CLOSE TO EXPOSED CABLE KIT OR RADIO
POOR GROUND PLANE FOR ANTENNA

IN SOME INSTALLATIONS, SOME OF THE ABOVE PROBLEMS CAN NOT BE AVOIDED. LATER VERSIONS OF THE HLN4925 PERSONALITY BOARD HAVE ADDED FIXES TO HELP WITH RFI. THE HLN4925D VERSION BOARD HAS MOST OF THESE FIXES, SO HNL4925 A, B AND C VERSIONS MAY REQUIRE THE FOLLOWING FIXES TO CURE SYNTHESIZER LOCK PROBLEMS AND BUZZING IN THE SPEAKER WHILE TRANSMITTING:

1) ADD C450, A 220pF CHIP CAPACITOR TO THE SOLDER SIDE OF THE HLN4925 PERSONALITY BOARD FROM U302 PIN 12 TO PIN 13. PN 2111031A47

2) SCRAPE THE SOLDER RESIST OFF OF THE PERSONALITY BOARD AS SHOWN IN THE ATTATCHED SKETCH.

THEN ADD 220pF CHIP CAPACITORS TO THE SOLDER SIDE OF THE HLN4925 PERSONALITY BOARD FROM P601 PINS 2, 4, 5, 7, 8 AND 9 TO THE SWITCHED 5 VOLT RUNNER ON THE EDGE OF THE BOARD.
PN 2111031A47

THE RFI PROBLEM WHERE THE RADIO SYSTEM RESETS WHEN KEYED IS MOST LIKELY CAUSED BY THE CONTROL HEAD. THE HLN1033A AND HLN1036A CONTROL HEADS REQUIRE THE FOLLOWING PARTS TO BE ADDED, THE "B" VERSION CONTROL HEADS ALREADY HAVE THESE FIXES:

1) ADD C109(220pF)ON THE SOLDER SIDE OF THE HLN1033 OR HLN1036 CONTROL BOARD FROM THE COLLECTOR OF Q15 TO THE GROUND PLANE OF THE MICROPROCESSOR SHIELD.
   PN 2111031A47

2) ADD C110(220pF) TO THE CONTROL BOARD ON TOP OF (PARALLEL WITH) R53.
   PN 2111031A47

3) ADD C111 (220pF) FROM BASE TO EMITTER OF Q5.
   PN 211031A47

C) NO RF POWER OUT (Q511)

THE FIRST THING TO CHECK IF THE TRANSMITTER WILL NOT KEY UP IS TO MEASURE THE KEYED 9.4 VOLT SUPPLY WHEN THE RADIO IS KEYED. THIS IS FOUND AT P601 PIN 1 ON THE PERSONALITY BOARD. IF ON A VALID TX MODE, THIS SHOULD BE FROM 9.3 TO 9.5 VOLTS WITH THE RADIO KEYED. IF NOT, INSPECT Q511. IT IS A TO92 TRANSISTOR ON THE COMPONENT SIDE, NEAR PIN 20 OF J601. IT CAN GET CRUSHED IF THE PERSONALITY BOARD IS NOT INSTALLED CAREFULLY. THIS CAN ALSO POSSIBLY CAUSE AN INTERMITTENT TX PROBLEM.

D) NO RECEIVE OR TRANSMIT AUDIO (Y300 OSCILLATOR)

THE CUSTOM FILTER IC U300 USES SWITCHED CAPACITOR FILTERS AND REQUIRES A 4 MHZ INPUT AT U300 PIN 24. THIS SIGNAL SHOULD BE A DISTORTED SINE WAVE AT ABOUT 450 mVOLTS PEAK TO PEAK. IF THERE IS NO 4 MHZ SIGNAL PRESENT AT PIN 24 REPLACE Y300, THEY SOMETIMES CHANGE IMPEDANCE AND THE OSCILLATOR CIRCUIT WILL NOT START UP RELIABLY.

E) NO MICROPHONE DEVIATION (1% R'S SHORTING)

IF NO MICROPHONE DEV IS PRESENT, INJECT AN 80 mVOLT 1KHZ TONE INTO PIN 27 OF THE RADIO'S FRONT CONNECTOR, J1. THIS SHOULD BE THROUGH A 10 uF CAPACITOR WITH THE POSITIVE LEAD ON PIN 27 (THE RADIO AND CONTROL HEAD USE THE MIC HI LINE FOR EEPROM ERASURE PROTECTION).

WHILE THE RADIO IS NOT KEYED, LOOK AT HY300 PIN 6. THE SAME SIGNAL SHOULD BE PRESENT. IF NOT CHECK R100, IT IS A CHIP RESISTOR NEAR THE FRONT CONNECTOR. IF THE 80 mVOLT SIGNAL IS AT HY301 PIN 6, KEY THE RADIO AND LOOK AT U301 PIN 12. WITH 80 mVOLTS IN, THE OP-AMP U301 PIN 12 SHOULD BE ABOUT 2 VOLTS. IF NOT CHECK THE TWO 1% RESISTORS R104 AND R105 ON THE COMPONENT SIDE NEAR U301. THESE PARTS CAN CRACK OR SHORT TOGETHER IF THE PERSONALITY BOARD IS NOT INSTALLED CAREFULLY.

F) SQUELCH TAIL NOISE BURST WHEN DEKEYING MICROPHONE

IF A SQUELCH TAIL IS HEARD ON DEKEY, MEASURE THE DC VOLTAGE ON HY301 PIN 7 WHEN RECEIVING A STRONG ON CHANNEL SIGNAL (1 mVOLT OR MORE RF LEVEL). THIS VOLTAGE SHOULD BE AT 4.0 VOLTS OR LESS WITH A STRONG SILENT CARRIER. IF NOT REPLACE HY301.

G) NO CONTROL HEAD DISPLAY (T1 LEAD CONTAMINATION)

IF THE CONTROL HEAD DISPLAY DOES NOT TURN ON AND THE BUTTONS STILL FUNCTION, OPEN THE CONTROL HEAD UP AND REFLOW THE 5 LEADS ON THE VF TRANSFORMER (T1). THE LEADS MAY HAVE BEEN CONTAMINATED AND DID NOT SOLDER PROPERLY, AFTER TIME THEY CORRODE AND LOSE CONTACT. THIS SEEMS TO FIX MANY DISPLAY PROBLEMS.

H) "A" SUFFIX CONTROL HEAD DISPLAY PROBLEMS

IF AN "A" VERSION CONTROL HEAD DEVELOPS DISPLAY PROBLEMS, CONTACT CUSTOMER SERVICES.

I) AUDIO POPPING DURING SCAN OR MODE CHANGING (U302)

CHECK U302. IT IS A 16 PIN SOCKETED DIP, AND SHOULD HAVE A WHITE DOT ON THE TOP OF THE PACKAGE. THE WHITE DOT SIGNIFIES THE PART HAS BEEN TESTED. IF NO WHITE DOT IS ON THE PART REPLACE IT WITH ONE THAT HAS BEEN TESTED.

J) INTERMITTENT OR NO SPEAKER AUDIO (HEAT SINK SHORTING)

THE AUDIO POWER AMP HEAT SINK SOMETIMES SHORTS THROUGH THE SOLDER RESIST UNDERNEATH AND SHORTS SIGNALS IN THE AUDIO PA TO CHASSIS GROUND.

MEASURE CONTINUITY FROM CHASSIS GROUND TO ALL OF THE FEED THROUGHS AROUND THE AUDIO PA HEATSINK. IF A SHORT IS FOUND, DRILL OUT THE RIVETS ATTACHING THE HEATSINK TO THE BOARD AND PUT A STRIP OF ELECTRICAL TAPE BETWEEN THE HEATSINK AND THE PC BOARD. THEN USE TWO SMALL SHEET METAL SCREWS TO ANCHOR THE HEATSINK BACK TO THE BOARD.

K) RADIO AND SIREN SYSTEM LOCKING UP
(NO CONTROL HEAD DISPLAY OR FUNCTION)

IF THE CONTROL HEAD OCCASIONALLY IS BLANK WHEN TURNED ON AND SEEMS TO CLEAR ITSELF AFTER CYCLING THE SWITCH, CHECK THE SYSTEM RESET LINE AT PIN 4 OF J1 IN THE SIREN. IF THE SIGNAL IS ACTIVE (HIGH) CHANGE R102 IN THE SIREN FROM 100KOHMS TO 33 KOHMS.

L) RADIO OR CONTROL HEAD THAT REQUIRES EEPROM REPROGRAMMING

THE MIC HI LINE (J1 PIN 27 IN THE RADIO) IS USED AS A WRITE PROTECTION LINE FOR BOTH THE RADIO AND CONTROL HEAD EEPROMS. THE EEPROM PROGRAMMER GROUNDS THE MIC HI LINE WHEN THE RADIO INTERFACE BOX IS CONNECTED TO THE SYSTEM TO DISABLE THE WRITE PROTECTION CIRCUITRY. IF A SYSTEM EVER REQUIRES REPROGRAMMING CHECK THE CR24 AND Q12 CIRCUIT IN THE CONTROL HEAD AND THE Q513 AND Q514 CIRCUIT IN THE RADIO. THIS SHOULD BE DONE WITH THE MIC HI LINE UNGROUNDED.

4) SYNTOR X 9000 ERROR CODE DESCRIPTION

FAIL 01/90 — CONTROL HEAD DID NOT RECEIVE RADIO'S POWER UP MESSAGE OVER SERIAL BUS

SOLUTION: SEE RADIO AND CONTROL HEAD SERIAL BUS SECTION

FAIL 01/82
FAIL 01/84 — RADIO EEPROM CORRUPTED OR BLANK

SOLUTION: CHECK THE POSITION OF J501/502. IF USING A 2K EEPROM (5197014B01) J501 SHOULD BE INSTALLED, AND IF USING AN 8K EEPROM (5197014B05) J502 SHOULD BE INSTALLED.

NOTE: A 2K EEPROM (5190714B01) IS A 24 PIN DIP AND THE SOCKET FOR U502 IS 28 PINS TO ACCEPT THE 8K PART. THE 2K PART MUST BE INSTALLED IN THE REAR 24PINS OF THE SOCKET (PINS 1,2,27 AND 28 LEFT OPEN).

TRY TO REPROGRAM RADIO EEPROM USING THE EPSON OR THE IBM PROGRAMMER. IF THE ERROR CODE GOES AWAY CHECK Q513,Q514 AND R530-R533 OR THE ERROR CODE MAY RE-APPEAR AFTER POWER IS CYCLED OR THE VEHICLE IS STARTED. THE EEPROM WRITE PROTECTION CIRCUITRY MAY BE FAULTY.

IF THE ERROR CODE DOES NOT GO AWAY CHECK THAT WHEN GROUNDING J1-27 THAT Q514 BASE IS AT 5 VOLTS. IF NOT FIND FAULT IN R530-R533 AND/OR Q513 AND Q514.

IF Q514 BASE DOES GO TO 5 VOLTS WITH J1-27 GROUNDED, REPLACE U502.

FAIL 05/90 — CONTROL HEAD NOT READING IT'S OWN SERIAL BUS MESSAGES

SOLUTION: CHECK THAT A SHORT BURST OF DATA APPEARS ON U1 PIN 13 IN THE CONTROL HEAD SHORTLY AFTER POWER UP.

IF NO DATA APPEARS, REPLACE U1.

IF DATA DOES APPEAR ON U1-13 CHECK Q1-Q3 AND R1-R9 FOR FAULT.

FAIL 05/82 CONTROL HEAD EEPROM BLANK OR CORRUPTED
FAIL 05/84

SOLUTION: CHECK THE POSITION OF JU4/JU5. IF USING A 2K EEPROM (5190714B01) JU4 SHOULD BE INSTALLED, AND IF USING AN 8K EEPROM (5190714B05) JU5 SHOULD BE INSTALLED.

NOTE: A 2K EEPROM (5190714B01) IS A 24 PIN DIP AND THE SOCKET FOR U502 IS 28 PINS TO ACCEPT THE 8K PART. THE 2K PART MUST BE INSTALLED IN THE REAR 24PINS OF THE SOCKET (PINS 1,2,27 AND 28 LEFT OPEN).

TRY TO REPROGRAM CONTROL HEAD EEPROM USING THE EPSON OR THE IBM PROGRAMMER. IF THE ERROR CODE GOES AWAY CHECK Q12,Q13 AND R36-R39 AND CR24 AND CR30 OR THE ERROR MAY REAPPEAR AFTER POWER IS CYCLED . THE EEPROM WRITE PROTECTION CIRCUITRY MAY BE FAULTY.

IF THE ERROR CODE DOES NOT GO AWAY CHECK THAT WHEN GROUNDING J1-27 THAT Q13 BASE IS AT 5 VOLTS. IF NOT FIND FAULT IN R36-R39 AND/OR Q12 AND Q13.

IF Q13 BASE DOES GO TO 5 VOLTS WITH J1-27 GROUNDED, REPLACE U2.

FAIL XX/90 OPTION XX DID NOT SEND A MESSAGE ON THE SERIAL BUS AFTER POWER UP

XX	OPTION	W-OPTION #(S)
08	SIREN/PA	
09	SECURENET	
0A AND 0B	FULL FEATURED MDC STATUS OR MESSAGE	
0C AND 0D	MVS AND OR MDC ID/EMERGENCY	
0E	DTMF/TELEPHONE INTERCONNECT	

SOLUTION: MAKE SURE OPTION XX IS INSTALLED PROPERLY THEN SEE OPTION MANUAL FOR TROUBLESHOOTING PROCEDURE.

5) PERSONALITY BOARD DIGITAL SECTION TROUBLESHOOTING

THE RADIO'S MICROPROCESSOR MUST BE FUNCTIONING AND BE ABLE TO COMMUNICATE OVER THE SERIAL BUS BEFORE ANYTHING IN THE SYSTEM WILL FUNCTION. IF THE CONTROL HEAD DOES NOT RECEIVE THE RADIO'S MESSAGES OVER THE BUS, THE DISPLAY "FAIL 01/90" WILL APPEAR ON THE CONTROL HEAD. ALSO, IF THE RADIO'S PROCESSOR CAN'T "TALK" ON THE BUS, THE SYNTHESIZER WON'T GET DATA AND WILL BE OUT OF LOCK.

FAIL 01/90 OR FLASHING "SELF CHECK" DISPLAY

THE FIRST THINGS TO CHECK ARE THE THREE POWER SUPPLIES. THE SYNTOR X 9000 HAS 3 SUPPLIES:

9.6 VOLTS RUNS OFF OF SWITCHED B+ (GREEN LEAD W/3 AMP FUSE)

SW5 VOLTS RUNS OFF OF SWITCHED B+ (GREEN LEAD W/3 AMP FUSE)

UNSW5 VOLTS RUNS OFF A+ (RED LEAD THROUGH 40 AMP FUSE AND R419)

ALL THREE OF THE SUPPLIES SHOULD BE CHECKED ON THE PERSONALITY BOARD IN THE SHIELDED AREA. UNSW5V AT U500-33, SW5V AT U501-1 AND 9.6V AT THE OPTION CONNECTOR J301-7.

L500 AND L502 HAVE BEEN KNOWN TO OPEN.

NEXT CHECK IF THE RADIO'S PROCESSOR IS RUNNING.

THIS IS DONE BY LOOKING AT HY500 PIN 2. THE SIGNAL SHOULD BE PULSED EVERY 1 TO 3 mSEC. IF NOT, THE MOST LIKELY PROBLEM IS U500, AND THE NEXT MOST LIKELY PART TO TRY IS U501, THE PROM.

IF HY500-2 IS NOT PULSED AND REPLACING U500 AND U501 DID NOT SOLVE THE PROBLEM CHECK THAT WHEN THE RADIO IS ON U500 PINS 7 AND 8 ARE BOTH AT 5 VOLTS. IF PINS 7 OR 8 ARE LOW, THE MICRPROCESSOR WILL NOT FUNCTION. IF PINS 7 AND 8 ARE NOT AT 5 VOLTS, CHECK Q516, Q517, CR508 AND THE RESISTORS IN THOSE CIRCUITS.

NEXT CHECK IF THE RESET LINE TO THE PROCESSOR IS AT 5 VOLTS. THE RESET LINE IS AT U500 PIN 6. THE LINE SHOULD BE AT 5 VOLTS FOR THE RADIO TO FUNCTION PROPERLY. THE WATCH DOG TIMER HYBRID HY500 GENERATES A RESET PULSE (LOW) SHORTLY AFTER POWER UP THEN HOLDS THE RESET LINE HIGH. THE HYBRID WILL GENERATE REPETETIVE RESET PULSES IF IT'S INPUT HY500 PIN 2 IS NOT STROBED AT LEAST EVERY 12 mSEC.

THE SERIAL BUS SIGNALS TO LOOK AT ARE RX DATA, TX DATA, BUSY OUT AND BUSY IN. THESE ARE ALL AT U500, AND ARE TO BE LOOKED AT WITH AN OSCILLOSCOPE.

THESE SIGNALS ARE ACTIVE WITH DATA ONLY A SHORT TIME AFTER POWER IS APPLIED BY THE CONTROL HEAD SWITCH. TO LOOK AT THE DATA SWITCH THE CONTROL HEAD OFF AND ON REPETITVELY AND LOOK AT TXDATA AT PIN 13 OF U500 AS THE SWITCH IS TURNED ON.

FOLLOW THE TX DATA SIGNAL FROM U500 PIN 13 THROUGH Q503 Q501 AND Q502. THE DATA SHOULD ALSO APPEAR AT THE COMPARATOR OUTPUT U505 PIN 6.

IF THE DATA IS NOT PRESENT AT U500 PIN 13 CHECK THE LEVEL OF U500 PIN 9. IF THIS SIGNAL IS STUCK LOW , THE RADIO ASSUMES THAT THE BUS IS BUSY AND WILL NOT SEND IT'S DATA.

IF U500 PIN 9 IS LOW CHECK Q508 AND Q509.

---

6) SYSTEMS 9000 METERING POINTS

METERING SOCKETS WERE REMOVED ON THE SYSTEMS 9000 PERSONALITY BOARD DUE TO THE HIGHER CIRCUIT DENSITY ON THE BOARD, THUS METERING IS LIMITED ON SYSTEMS 9000.

SINCE THE RF BOARD IS UNCHANGED ON A SYSTEMS 9000, THE SAME METERING POINTS ARE AVAILABLE AS BEFORE IN THE SYSTEMS 90 RECEIVER, VCO, AND TRANSMITTER.

THE POWER CONTROL METERING SOCKET REMAINS ON THE VHF AND 800 MHZ BAND RADIOS AS BEFORE.

THE MISSING SIGNALS ON SYSTEMS 9000 COMPARED TO SYSTEMS 90 RADIOS ON THE PERSONALITY BOARD ARE:

SIGNAL NAME	SYSTEMS 90 LOCATION	SYSTEMS9000 LOCATION
9.6V	J2 PIN 4	P601/602 PIN 18
SWB-	J2 PIN 6	P601/602 PINS 15 & 16
SPEAKER HI	J2 PIN 2	T400 PIN 4
SPEAKER LO	J2 PIN 1	T400 PIN 3
PTT	J2 PIN 5	SEE NOTE 1 BELOW
MIC HI	J2 PIN 7	SEE NOTE 2 BELOW

NOTES:

1) PTT IS ACTIVE HIGH ON SYSTEMS 90, GROUNDING J1 PIN 1 ON THE PERSONALITY BOARD ON A SYSTEMS 9000 RADIO WILL CAUSE THE RADIO TO KEY UP IF ON A VALID TRANSMIT MODE.

CAUTION: USE CARE IF NOT FAMILIAR WITH SYSTEMS 9000 OR SIGNAL GENERATOR DAMAGE MAY RESULT.

2) THE MIC HI LINE IS USED TO PROTECT THE RADIO AND CONTROL HEAD EEPROMS, USE A 10 uF ELECTROLYTIC CAPACITOR IN SERIES WITH AUDIO INPUT WITH POSITIVE LEAD ON J1 PIN 27 TO INPUT MICROPHONE AUDIO.

TROUBLESHOOTING THE SYNTHESIZER

The most common problem found in a Syntor X 9000 Mobile Radio is the open loop. This is identified by the Out Of Lock indicator CR602 (the red LED ont the RF board) flashing. Though this light may be lit when you first turn on the radio, you can't visually determine if the fault lies in the Synthesizer section. The fault may be found in one of four major sections:

1. Voltage Regulation
2. Microprocessor
3. Synthesizer
4. VCO

To determine where there problem is, the following checks must be made:

1. **Measure** the regulated voltages applied to the Synthesizer section (**9.6vdc** and **5vdc**). Also measure the synthesizer generated voltage (**8.6vdc**). All must be good.

2. Using an o'scope, **check the Data/Address lines** coming from the Microprocessor Section. These can be checked at the Divider IC U602. **Be sure to look at ALL data/address pins!** Many technicians do not have the ability to detect if each bit is correct, **all that needs to be looked for is activity (0vdc to 5vdc squarewave). While making these checks vary the control head mode selector.**

3. **Perform an Open Loop test. If the problem is in the Synthesizer or VCO section this test MUST be performed!**

   a. Desolder test jumper JU600.

   b. Connect a known good vaariable DC supply to the side of JU600 which is connected to J650-2. (This is the VCO steering line. It is used to control the frequency of the VCO.)

   c. Connect a spectrum analyzer (or high impedance o'scope) to P600/J600 (RCA plug beneath the Common Circuits board). This is the VCO's output.

   d. Vary the DC supply that is connected to JU600. While this change is made, the spectrum analyzer (or o'scope) should indicate a change in VCO frequency .

   e. **If the frequency changes, you now need to apply a CONSTANT DC potential to the steering line.** Watch the spectrum analyzer (o'scope). If the frequency varies, the problem is in the VCO section. If the frequency remains constant, the problem is in the

synthesizer section.

4. (If the problem is in the synthesizer section.)
Keep the constant DC source connected to P600/J600.

a. Using the spectrum analyzer (o'scope) monitor the output of the Prescaler (U601-3). This should be approximately one-third the VCO frequency.

b. Monitor the inputs to the Divider IC (U602).

1. pin 25: approximately one-third the VCO frequency.

2. pin 2: 14.4MHz from the Reference Oscillator.

c. Monitor the ouputs of the Divider IC (U602).

1. pin 9: Loop Out: 5KHz or 6.25KHz (different if a special product)

a) The Loop Out pulses should change if the DC supply is changed. This change indicates U602 is dividing properly.

2. pin 5: Ref Out: 5KHz or 6.25KHz (different if a special product)

a) This should be steady! It indicates the Ref Oscillator's 14.4MHz is being divided properly.

* **IF EITHER PIN 9 OR PIN 5 DO** NOT PROVIDE PROPER INDICATIONS, REPLACE THE DIVIDER IC (U602) *

d. REFERENCE VOLTAGES CAN BE FOUND IN THE SYNTHESIZER TAB TABLE 3.

Monitor the inputs of the Phase Detector IC (U603).

The Phase Detector is the noisest and the high failure IC in the Synthesizer section.

1. pin 2: Ref In: should look the same as U602-5.

2. pin 23: Loop In: this is a differentiated Loop Out signal (U602-9).

e. Monitor the waveforms around the Phase Detector IC while **varying the DC supply.** For the Phase Detector IC to check good, U603-17 Ext PNP Base, should switch high and low when the DC supply is switched between its limits.

The above checks should get you to the problem circuitry. The IC's are not always the bad component. The following IC's, however, have been known to fail more than others in the synthesizer section:

1. **Prescaler (U601):** If it fails the radio is **usually able to lock up on a frequency. This frequency is** normally in the range of 800KHz to 1.5MHz!

2. **Divider (U602):** If it fails the output Loop Out waveform will not change when the DC supply is varied. The dividers do NOT divide.

3. **Phase Detector (U603):** If it fails the steering line voltage will cause the VCO to be tuned to the wrong frequency. When the DC supply is varied the Ramp Cap Voltage (U603-24) will not vary.

* **All the above IC's are soldered in, not socketed. It is recommended that the sockets should NOT be replaced when replacing the IC. Socket CORRESION is ALWAYS** a problem!

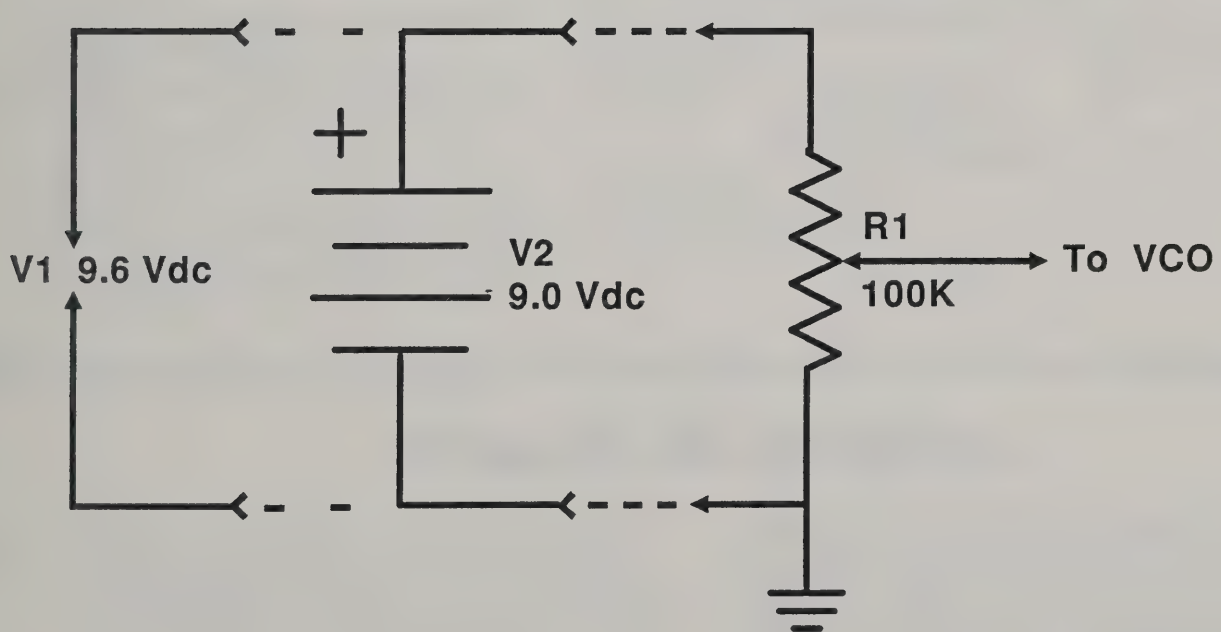
FREQUENCY SYNTHESIZER VARIABLE POWER SUPPLY

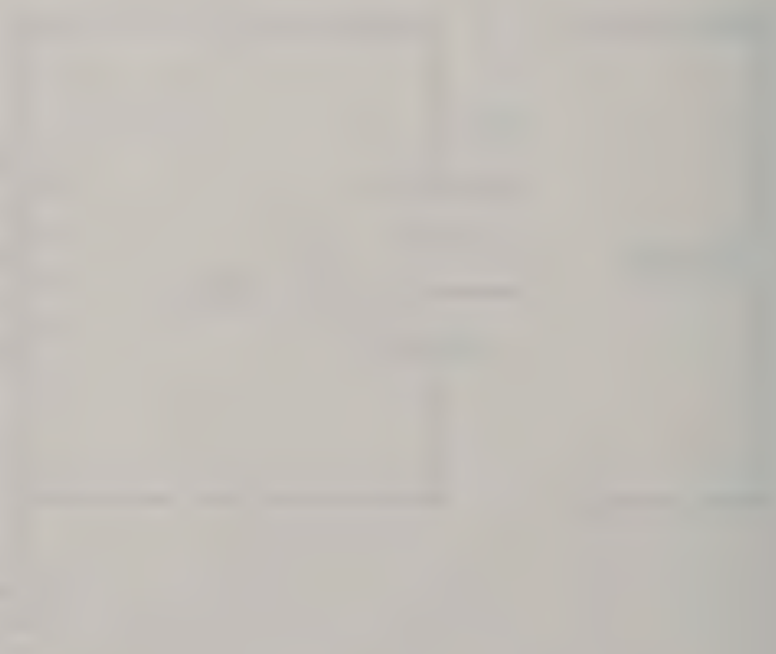
OPEN LOOP TEST

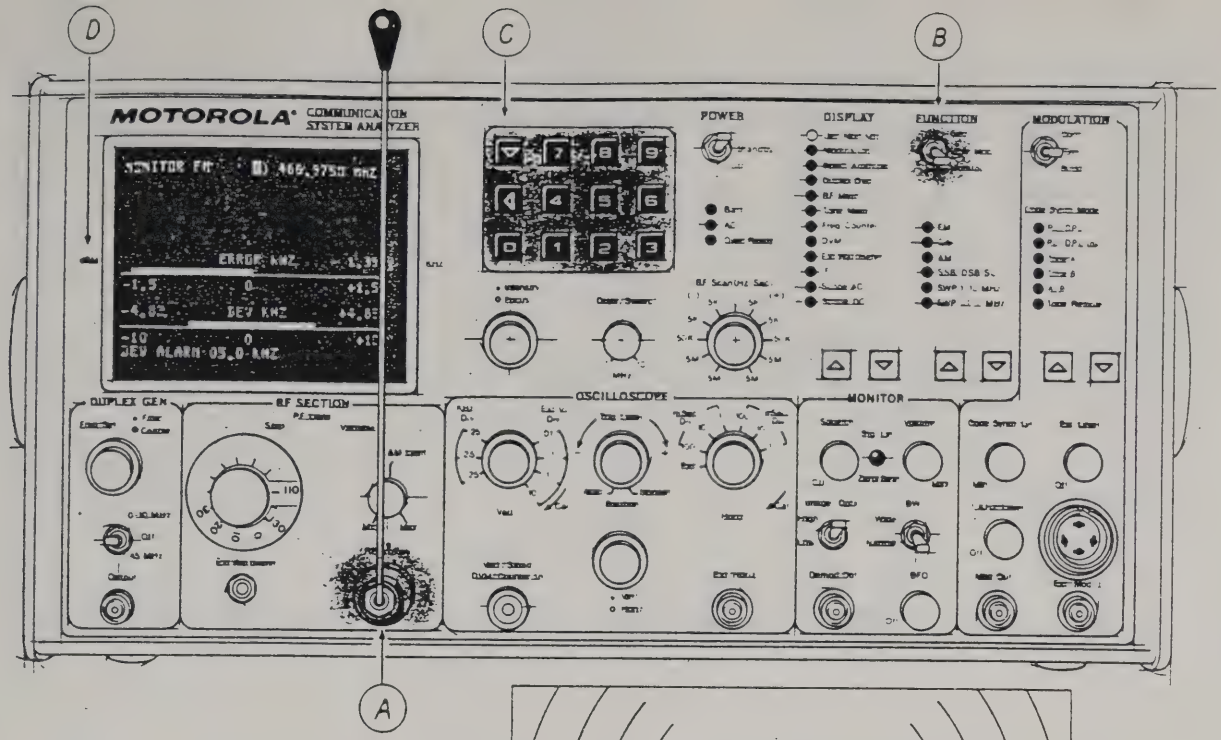
In order to perform the open loop test a variable power supply is needed. A simple variable power supply can be constructed using a 100K ohm resistor, 9 Vdc battery and some jumpers as shown below.

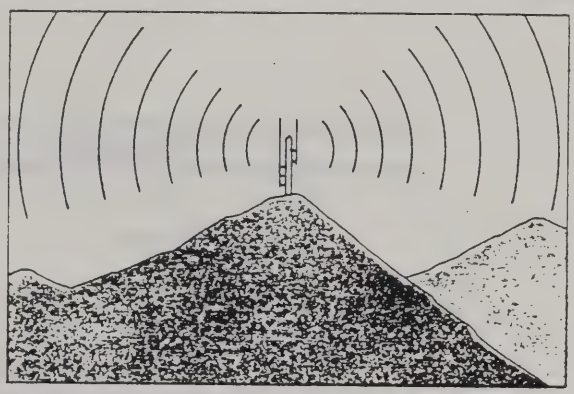
In the synthesizer section of the technical manual it is recommended that a 1K ohm resistor is placed in series with the variable voltage source. Using the 100K ohm potentiometer we have not had to use the 1K ohm resistor.

PART NUMBER: R1 18-82787K08









EXAMPLE: SET-UP TO MONITOR FREQUENCY, DEVIATION AND AUDIO OF DISTANT TRANSMITTER BY USE OF THE "MONITOR" FUNCTION.

A. CONNECT ANTENNA TO RF IN/OUT CONNECTOR.

B. SET FUNCTION SWITCH TO MONITOR AND DISPLAY TO GEN/MON MTR.

C. SELECT FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD.

D. READ FREQUENCY ERROR AND DEVIATION AND LISTEN TO RECEIVED AUDIO FROM INTERNAL SPEAKER OR VIEW ON MODULATION OSCILLOSCOPE.

Frequency Range: 1 MHz to 999.9999 MHz
Resolution: 100 Hz
Input Sensitivity: 1.5μV for 10 dB EIA Sinad (narrow band ±6 kHz mod. acceptance) or 7μV for 10 dB EIA Sinad (wide band ±100 kHz mod. acceptance)

Deviation Measurement

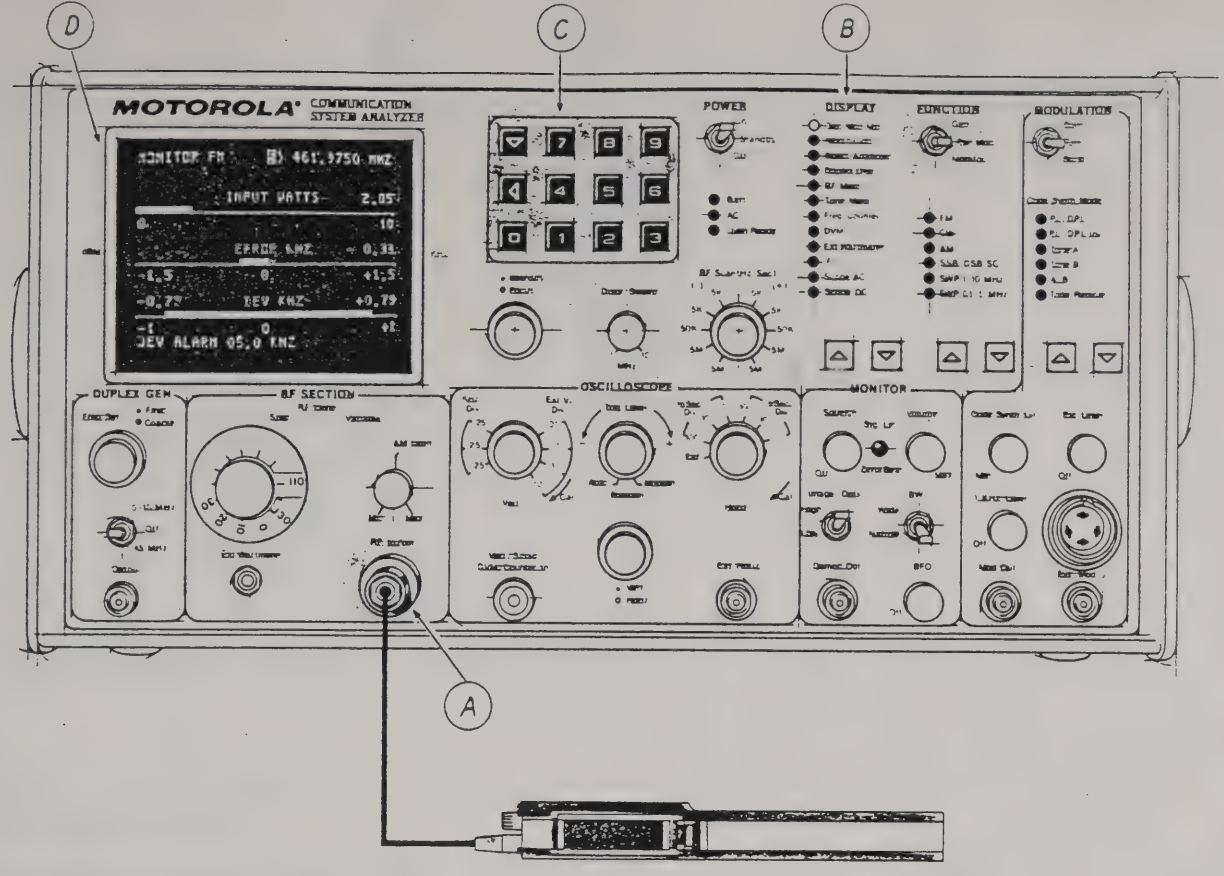
Range: 1, 10, 100 kHz full scale
Peak Deviation Limit: Set via keyboard to 100 Hz resolution. Audible alarm.

AM Modulation Measurement

Range: 0 to 100%
Accuracy: ±5% of full scale

It's an off-the-air monitor.

In the Monitor mode, the display indicates receiver frequency, frequency error and incoming signal modulation levels. Sensitivity is 1.5 microvolts. For FM receive, the audible deviation alarm limit is also displayed. Frequency error and Modulation indicators are autoranging simultaneous analog and digital presentations. The display may be switched to observe modulation waveforms on the large 8 cm x 10 cm oscilloscope display. The Monitor mode may also be used for receiving WWV or other frequency standard transmissions allowing direct calibration of the System Analyzer time base.



PORTABLE RADIO UNDER TEST

EXAMPLE: FM RADIO SET-UP FOR TRANSMITTER POWER, FREQUENCY, AND DEVIATION MEASUREMENT USING "POWER MONITOR" FUNCTION

A. CONNECT RF IN/OUT TO RADIO ANTENNA CONNECTOR.
B. SET FUNCTION SWITCH TO PWR MON AND DISPLAY TO GEN/MON MTR.
C. SELECT FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD.
D. KEY TRANSMITTER AND READ POWER OUTPUT, FREQUENCY ERROR AND MODULATION LEVELS.

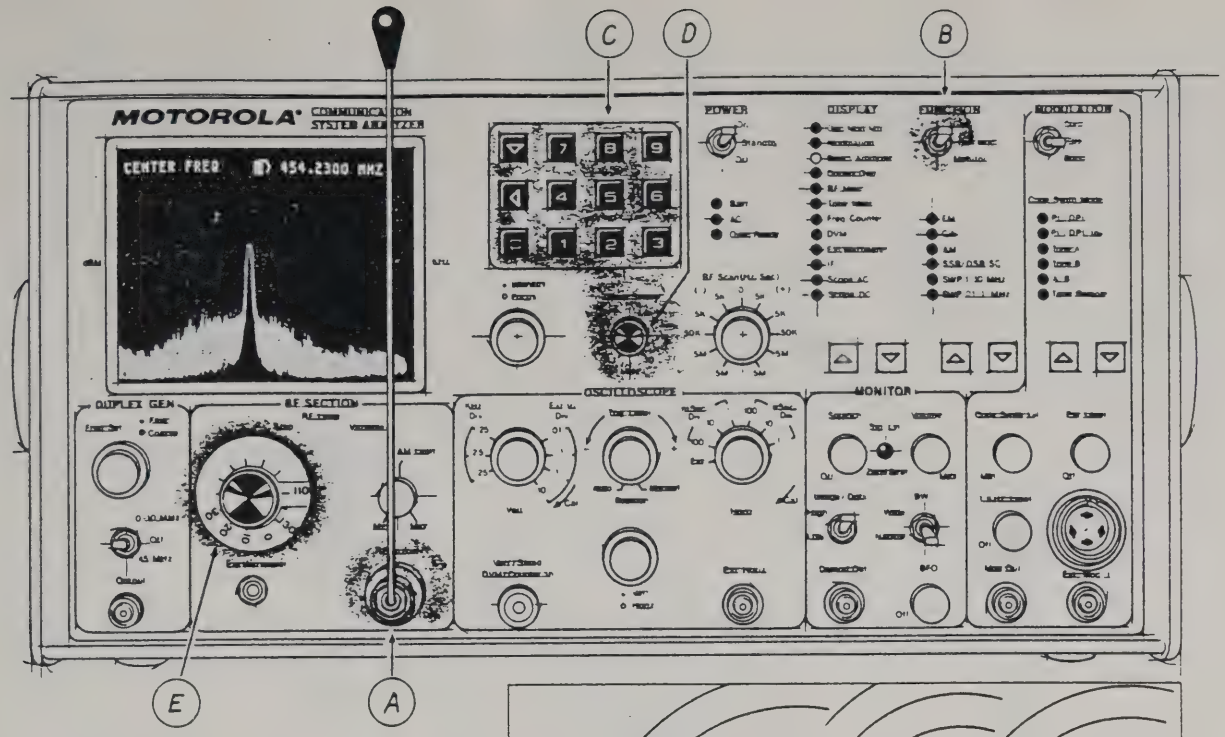
Built-in RF Wattmeter (Autoranging display)
Frequency Range: 1 MHz to 1000 MHz
Power Range: .2 watts to 125 watts
Accuracy: ±10%

It's a power monitor.

The Power Monitor mode is provided to allow simultaneous transmitter power, frequency error and modulation measurements with separate autoranging digital and analog meter-bar displays. The internal 125-watt load is used for terminating the transmitter.

An External Wattmeter input is also provided for on-screen displays of simultaneous forward and reflected power sensed by Motorola ST-1200 Wattmeter elements.

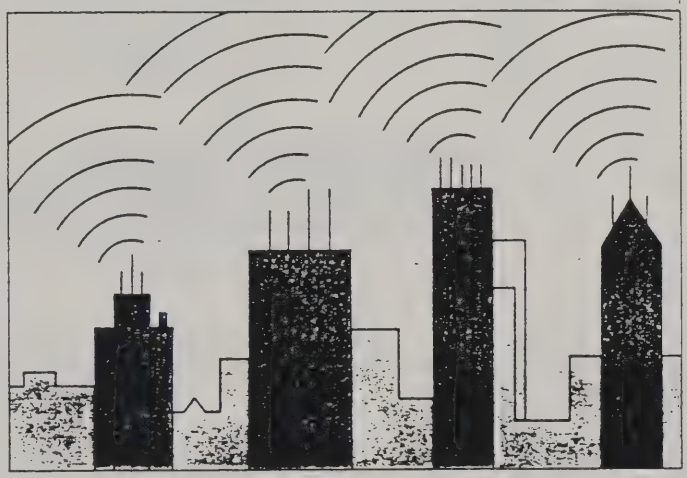
Note that a single RF connector is used for both Generate and Monitor functions.



EXAMPLE: LOCATING INTERFERENCE WITH BUILT-IN SPECTRUM ANALYZER.

A. CONNECT ANTENNA TO RF IN/OUT CONNECTOR.
B. SET FUNCTION SWITCH TO GEN. AND DISPLAY TO SPECT. ANALYZER.
C. SELECT CENTER FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD.
D. ADJUST DISPR/SWEEP CONTROL FOR DESIRED SPECTRUM SPAN.
E. ADJUST STEP ATTENUATOR IF REQUIRED TO REDUCE SENSITIVITY OR SET RECEIVE SIGNAL LEVELS.

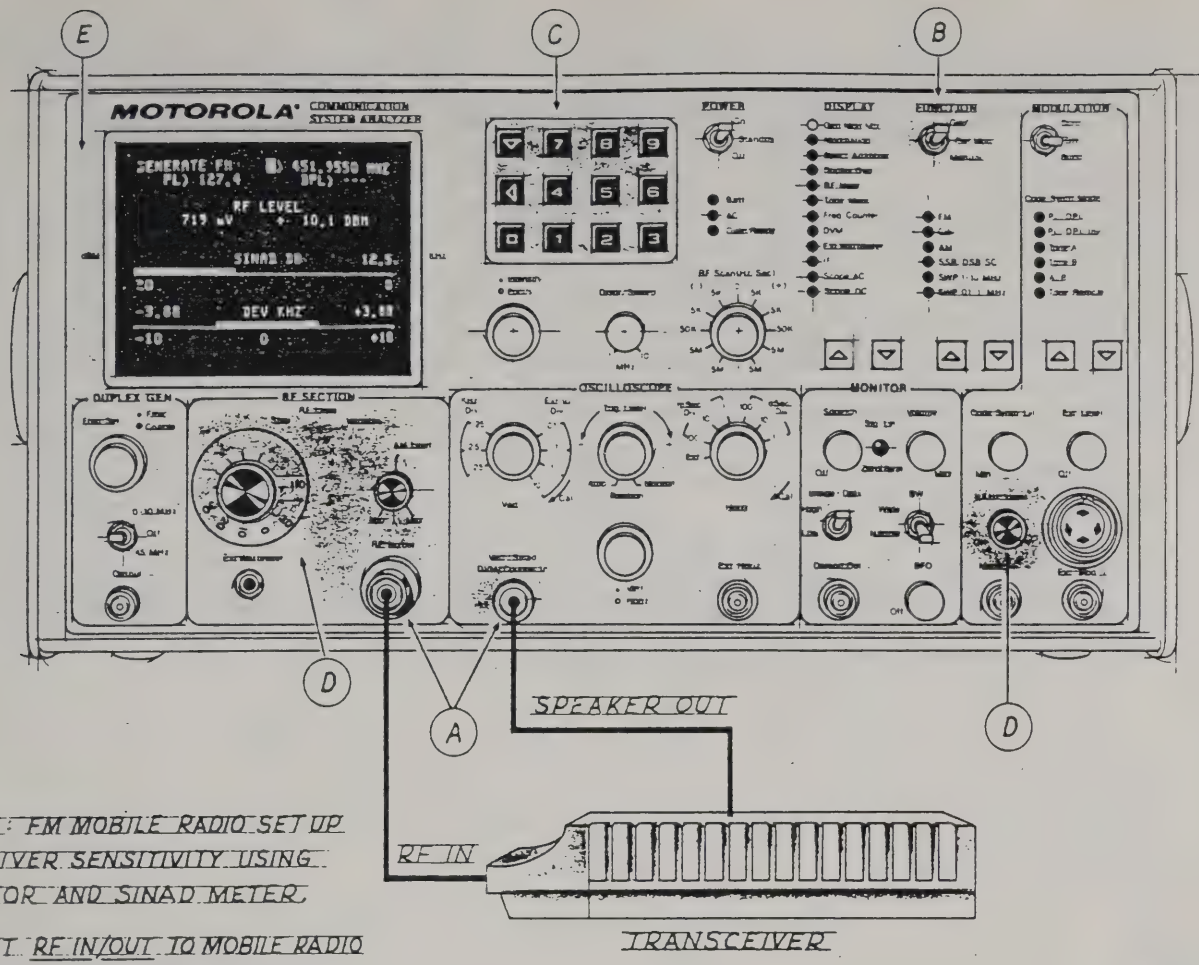
NOTE: THE SPECTRUM ANALYZER ALSO WORKS IN POWER MONITOR MODE FOR TRANSMITTER TESTING WITH THE BUILT-IN 125 WATT DUMMY LOAD.



Dynamic Range: ≧ 75 dB, −105 dBm to +20 dBm with step attenuator
Frequency Range: 2 MHz to 1,000 MHz
Full Scale Frequency Dispersion: Adjustable between 1 MHz and 10 MHz

It's a spectrum analyzer.

The significant advantage of spectrum visibility is provided to the Motorola Communications System Analyzer user through the integral Spectrum Analyzer Function. Center frequency is determined by keyboard entry and is displayed to 100 Hz accuracy. An RF Scan feature also provides tuning of the Spectrum Analyzer center frequency at selectable rates from 500 Hz to 5 MHz per second. The display width is continuously variable from 1 to 10 MHz and the use of the internal step attenuator allows maximum flexibility for on and off-site measurements.



EXAMPLE: FM MOBILE RADIO SET UP FOR RECEIVER SENSITIVITY USING GENERATOR AND SINAD METER.

A. CONNECT RF IN/OUT TO MOBILE RADIO ANTENNA CONNECTOR AND MULTIPURPOSE MEASUREMENT INPUT TO RECEIVER AUDIO OUTPUT.
B. SET FUNCTION SWITCH TO GEN. AND DISPLAY TO GEN/MON MTR.
C. SELECT FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD
D. ADJUST 1 KHZ LEVEL FOR 3.0 KHZ DEVIATION AND RF LEVEL FOR 12 DB SINAD INDICATION.
E. READ RECEIVER SENSITIVITY IN MICROVOLTS OR DBM.

Frequency Range: 10 kHz to 999.9999 MHz
Resolution: 100 Hz

Output
.1μV to 1 VRMS(−127dBm to +13 dBm)

Spectral Purity
Spurious: ≦ −40dB
Harmonics: ≦ −15dB

Frequency Modulation
Deviation: 0-50 kHz peak
Modes: Internal, external, microphone or all simultaneously

Amplitude Modulation
Range: 0 to 80% with ±10% full scale readout accuracy
External/Internal Frequency Range: 5 Hz-10 kHz (±1 dB)
Modes: Internal, external, microphone or all simultaneously

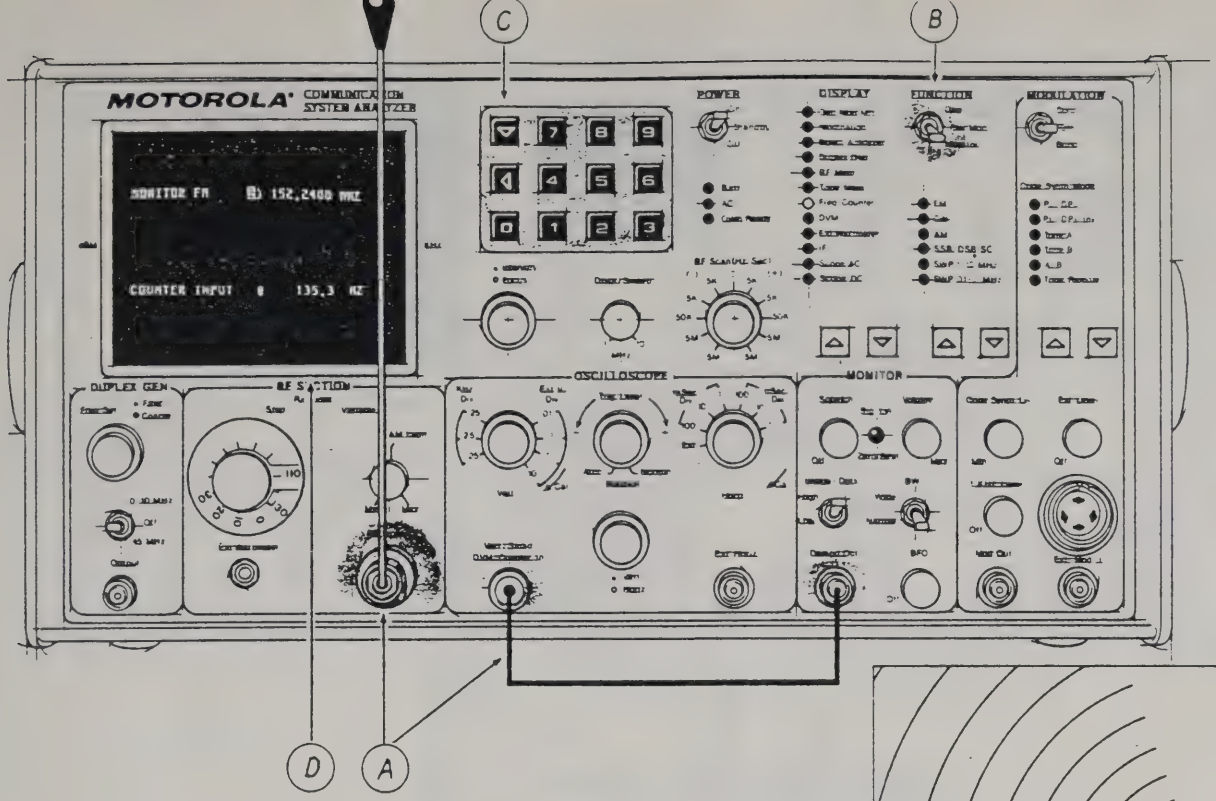
Double Sideband Suppressed Carrier
Carrier Suppression: ≧ 25 dB (1 MHz-500 MHz)

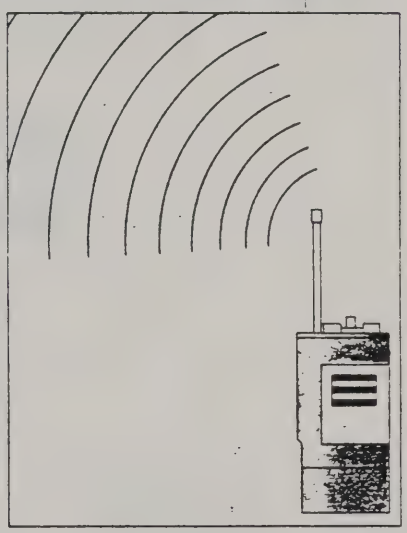
SINAD Meter
Input Level Range: .5V to 10 VRMS
Sinad Accuracy: ±1 dB at 12 dB Sinad

It's a signal generator and sinad meter.

When generating an FM, AM, CW or DSBSC signal, the display provides a complete summary of all parameters. The carrier frequency, RF level in volts and dBm, deviation or percent modulation and **Private Line** (PL) or **Digital Private Line** (DPL) code selected are all shown. Generated modulation waveforms may alternately be displayed at the touch of a button and simultaneous test tone and microphone audio modulation of the signal generator is possible.

The generator carrier frequency is key board selected and may be automatically tuned up or down at a variable rate by using the RF Scan control. In addition, an internal SINAD meter is active in the generate mode allowing this effective receiver performance measurement in one easy step. The SINAD and Modulation indicators are autoranging and provide both digital and analog "meter-bar" readouts.





EXAMPLE: MEASUREMENT OF TRANSMITTED "P.L." TONE BY MONITOR WITH INTERNAL FREQUENCY COUNTER

A. CONNECT ANTENNA TO R.F. IN/OUT CONNECTOR AND MULTIPURPOSE MEASUREMENT INPUT TO MONITOR DEMOD OUT.

B. SET FUNCTION SWITCH TO MONITOR AND DISPLAY TO FREQ. COUNTER.

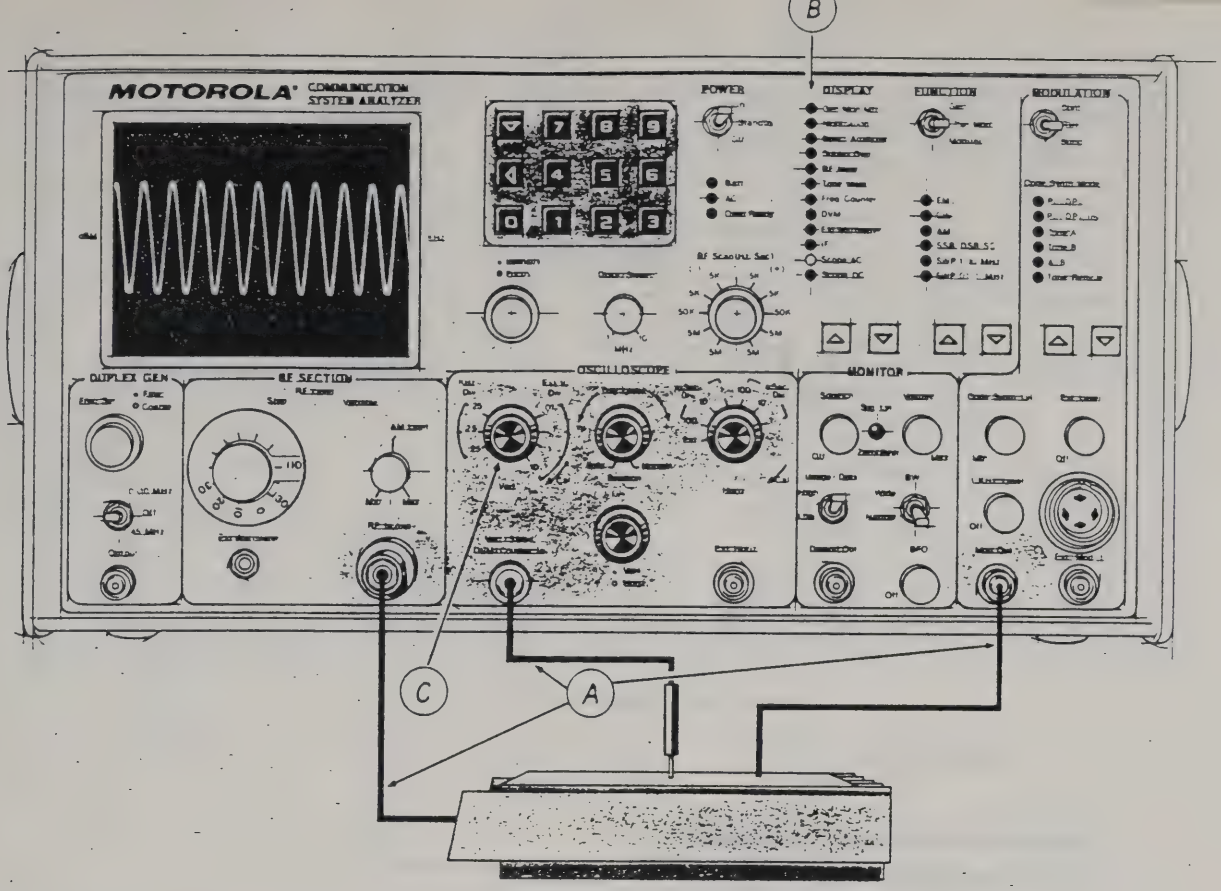
C. SELECT RF FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD AND KEY TRANSMITTER WITH PL MODULATION ONLY.

D. READ PL FREQUENCY ON COUNTER DISPLAY AFTER ONE FULL GATE PERIOD.

Frequency Range: 10 Hz to 35 MHz
Input Sensitivity: 30mV from 10 Hz to 1 MHz
50mV from 1 MHz to 35 MHz

It's a frequency counter.

A Frequency Counter mode is provided to measure frequencies between 10 Hz and 35 MHz. The auto-ranging display presents a full five-digit readout, with a maximum resolution of 0.1 Hz. The Counter function may be selected while the analyzer continues to function in basic Monitor or Generator operating modes.



EXAMPLE: USING OSCILLOSCOPE FOR TROUBLESHOOTING TRANSMITTER AUDIO STAGES. 1KHZ TEST TONE AND TERMINATING LOAD SUPPLIED BY ANALYZER.

A. CONNECT RF IN/OUT TO ANTENNA CONNECTOR, CONNECT PROBE TO MULTIPURPOSE MEASUREMENT INPUT, AND CONNECT MOD OUT 1KHZ TEST TONE TO TRANSCEIVER AUDIO INPUT.

B. SET FUNCTION SWITCH TO PWR MON (TO USE BUILT-IN DUMMY LOAD) AND DISPLAY TO SCOPE AC.

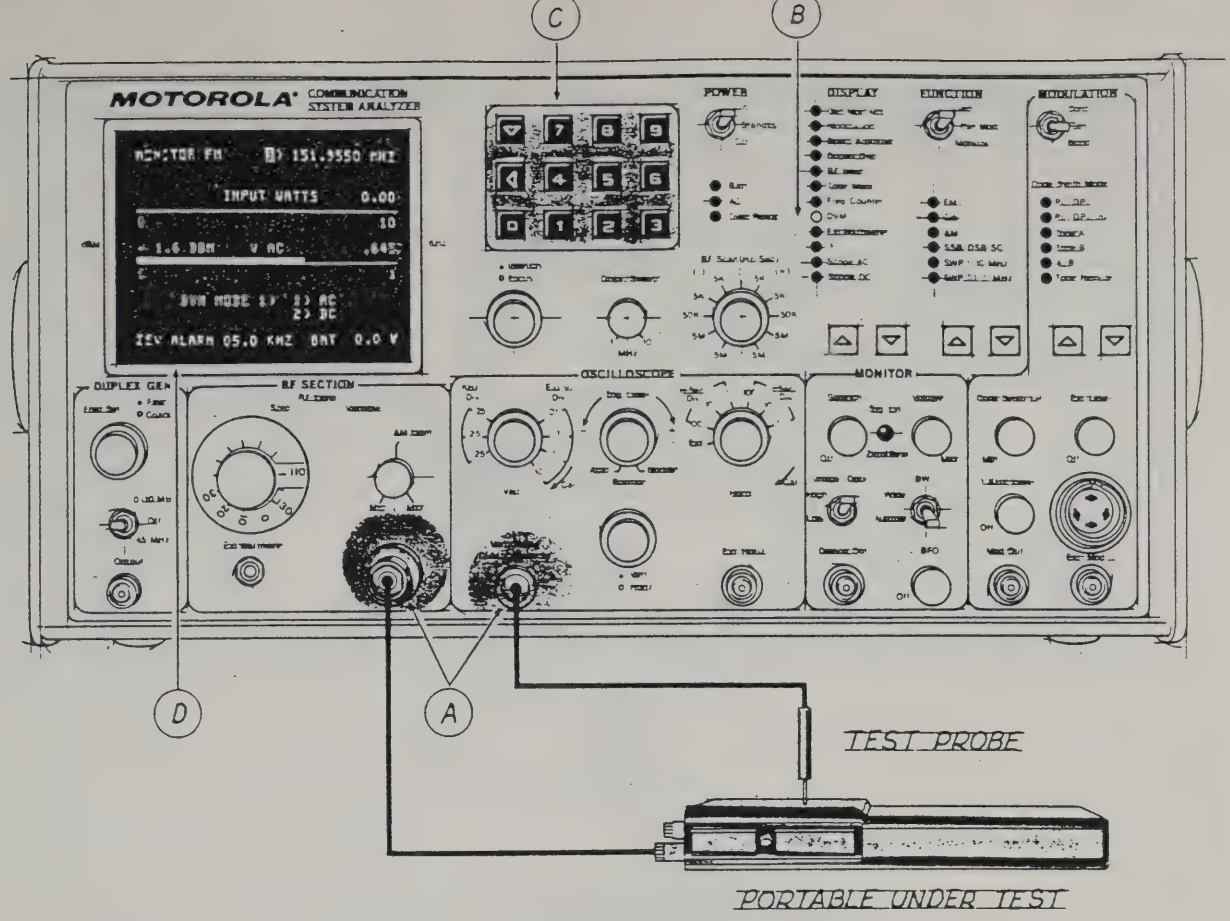
C. ADJUST OSCILLOSCOPE CONTROLS FOR DESIRED TRACE.

NOTE: THE OSCILLOSCOPE CAN BE USED TO TROUBLESHOOT RECEIVERS AND SQUELCH CIRCUITS WHILE USING THE GENERATOR AND CODE SYNTHESIZER AS A MODULATED SIGNAL SOURCE.

Screen Size: 8 cm x 10 cm
Frequency Response: DC to .5 MHz
External Vertical Input Ranges: 10mV, 100mV, 1V, 10V (per division)
Sweep Rates: 1μs, 10μs, .1ms, 1ms, .01S, .1S (per division)
Sync: Automatic or adjustable level triggering

It's an oscilloscope.

The large-screen display is readily usable as a separate fully calibrated 500 KHz oscilloscope. Vertical and horizontal inputs are switchable between external and internal sources. Internal vertical sources provide modulation waveforms or monitor IF output display. Horizontal sweep is automatic or triggered at adjustable levels.



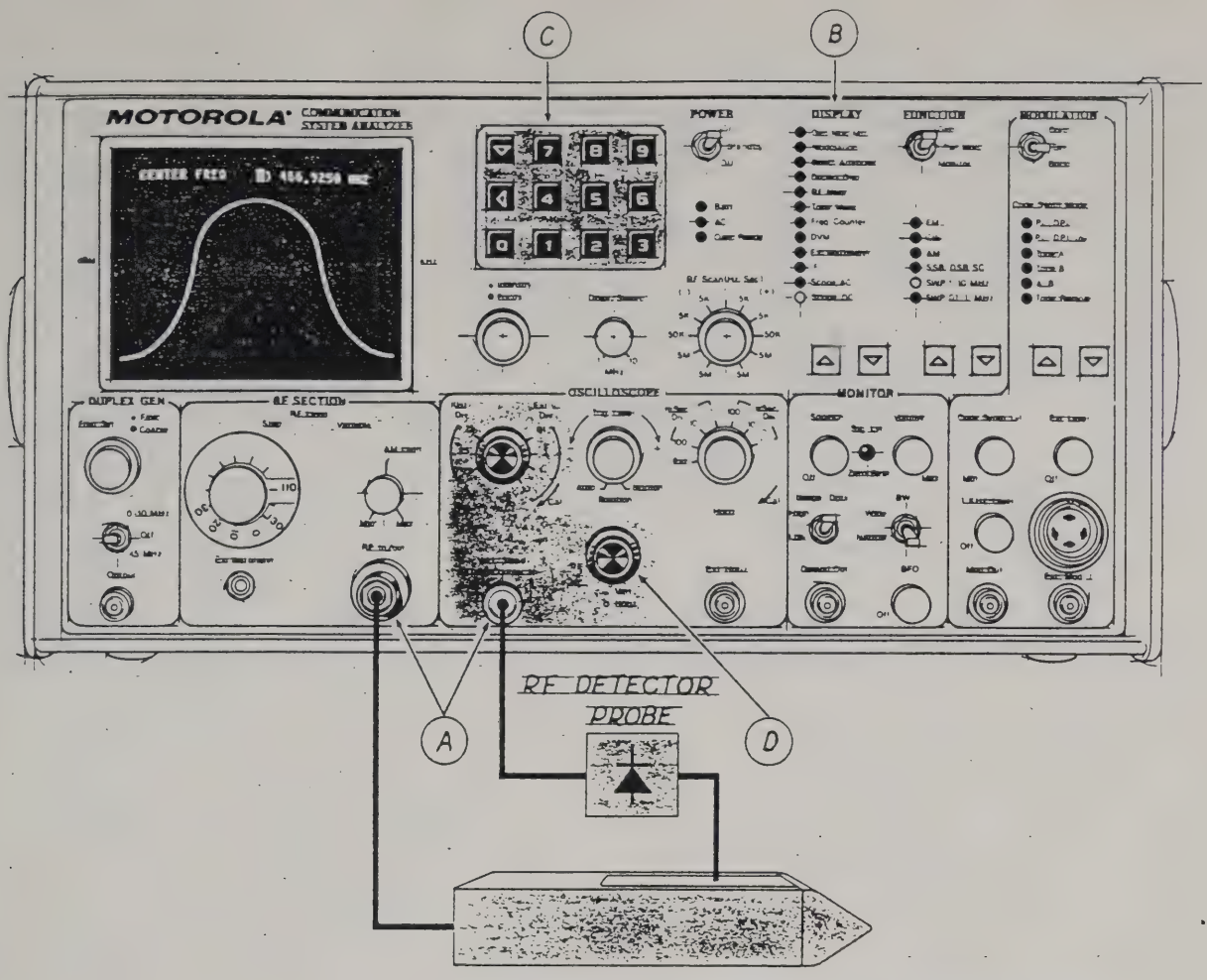
EXAMPLE: MAKING DIGITAL/ANALOG VOLTAGE MEASUREMENTS WHILE IN POWER MONITOR MODE.

A. CONNECT RF IN/OUT TO TRANSCEIVER ANTENNA CONNECTOR AND VOLTMETER PROBE TO MULTIPURPOSE MEASUREMENT INPUT.
B. SET FUNCTION SWITCH TO PWR MON AND DISPLAY TO DVM.
C. SELECT FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD.
D. READ VOLTAGE ON DISPLAY. AC OR DC MODE SELECTABLE VIA KEYBOARD.

DC Accuracy: ±1% of full scale ±1 least significant digit
AC Accuracy: ±5% of full scale
AC Bandwidth: 50 Hz to 10 kHz
Scales: 1, 10, 100, 300 volts full scale

It's a digital voltmeter.

The Motorola Communications System Analyzer contains a general purpose three and one half digit, AC and DC Voltmeter. The display provides an autoranging analog and digital presentation of AC or DC voltages. In addition, the dBm equivalent of the AC voltage across 600 ohms is simultaneously displayed. For those units equipped with the optional battery pack, continuous battery voltage monitoring is presented on the display. Like the Frequency Counter function, the DVM function is available simultaneously with the basic Monitor and Generator operating modes.



EXAMPLE: SWEEPING RECEIVER RESPONSE FROM ANTENNA TO IF TEST POINT USING EXTERNAL RF DETECTOR PROBE

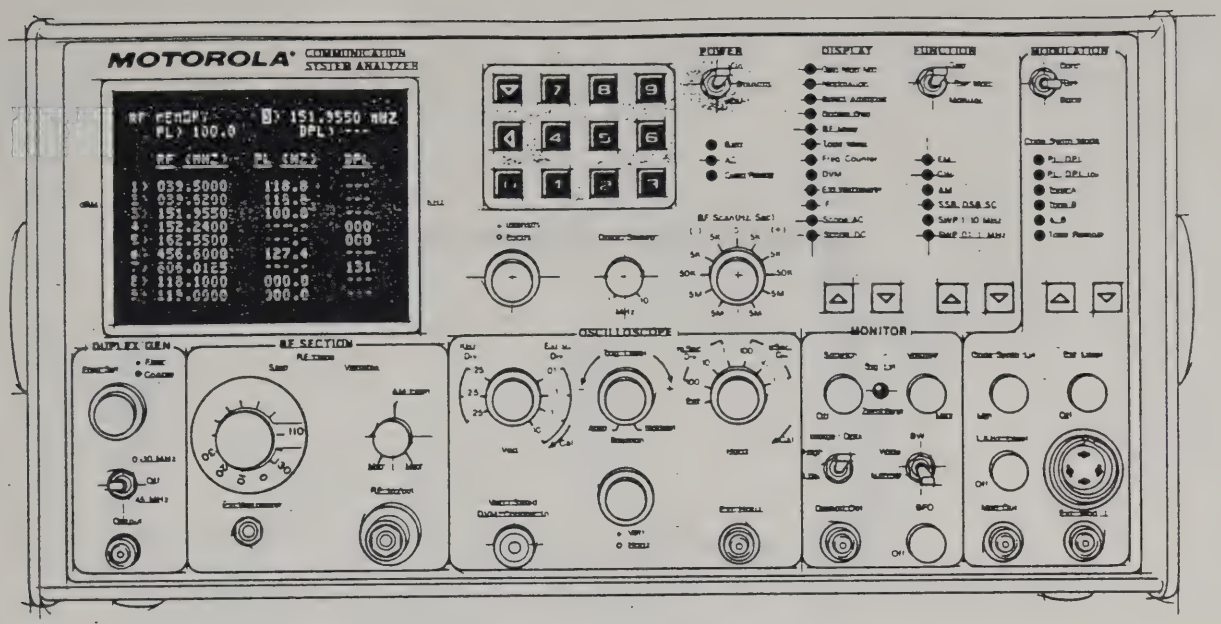
A. CONNECT RF IN/OUT TO RECEIVER ANTENNA CONNECTOR AND RF DETECTOR BETWEEN IF TEST POINT AND MULTIPURPOSE MEASUREMENT INPUT.
B. SET FUNCTION SWITCH TO GEN SWP AND DISPLAY TO SCOPE DC.
C. SELECT CENTER FREQUENCY FROM MEMORY TABLE OR ENTER DIRECTLY FROM KEYBOARD.
D. ADJUST OSCILLOSCOPE VERT CONTROL FOR DESIRED TRACE.

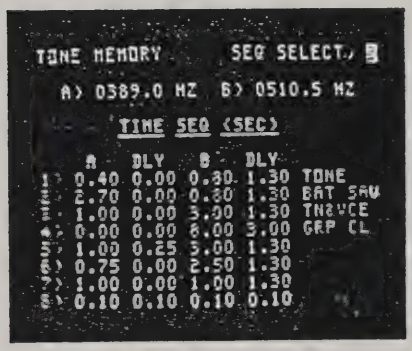
Sweep Width: 10 kHz to 10 MHz in two variable ranges.

It's a sweep generator.

The RF Generator can be easily configured for Automatic Sweep operation. The sweep width is continuously variable over the ranges of .01-1 MHz and 1-10 MHz.

When the function selector is in the sweep position with the display mode selected for AC or DC scope, the sweep signal is automatically coupled to the scope horizontal input to facilitate a sweep display. By using an external RF detector, bandpass filter and cavity responses can be clearly displayed.





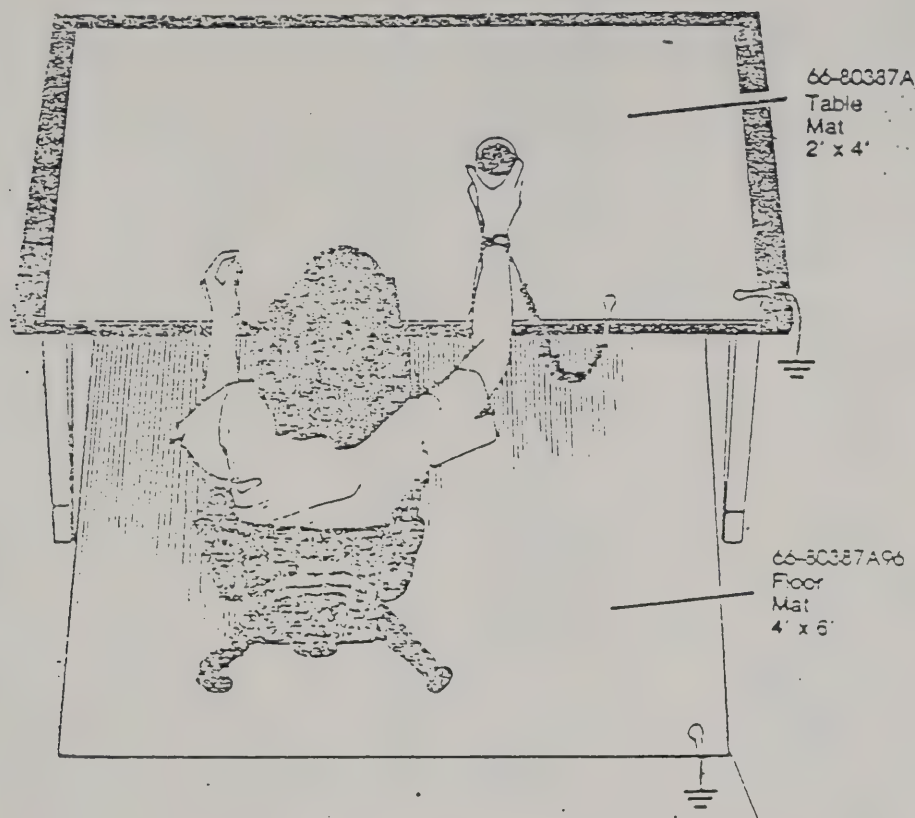
It provides RF frequency storage.

RF Memory Table. An internal, non-volatile memory provides storage and display for nine user-programmable RF frequencies and their corresponding **Private Line** (PL) or **Digital Private Line** (DPL) codes. Each frequency can be entered or changed by use of the keyboard. During Communications System Analyzer operation, the memory provides one-button recall which sets operating frequency for any mode.

It provides tone signalling data storage.

Tone Memory Table. The Tone Memory mode displays pre-programmed time intervals for all standard Motorola Two-tone Sequential paging systems. The remaining four timing sequences can be user-programmed based on specific requirements. Desired frequencies for Two-tone paging, **Private Line** (PL) and Tone-Remote Control are entered via the keyboard and displayed in the space provided. All operator entered data is placed in non-volatile memory and can be changed at any time. Any tone signaling code generated by the Communications System Analyzer is available at the Modulation output jack in addition to being used internally to modulate RF signals.

Anti-Static Grounding Kit

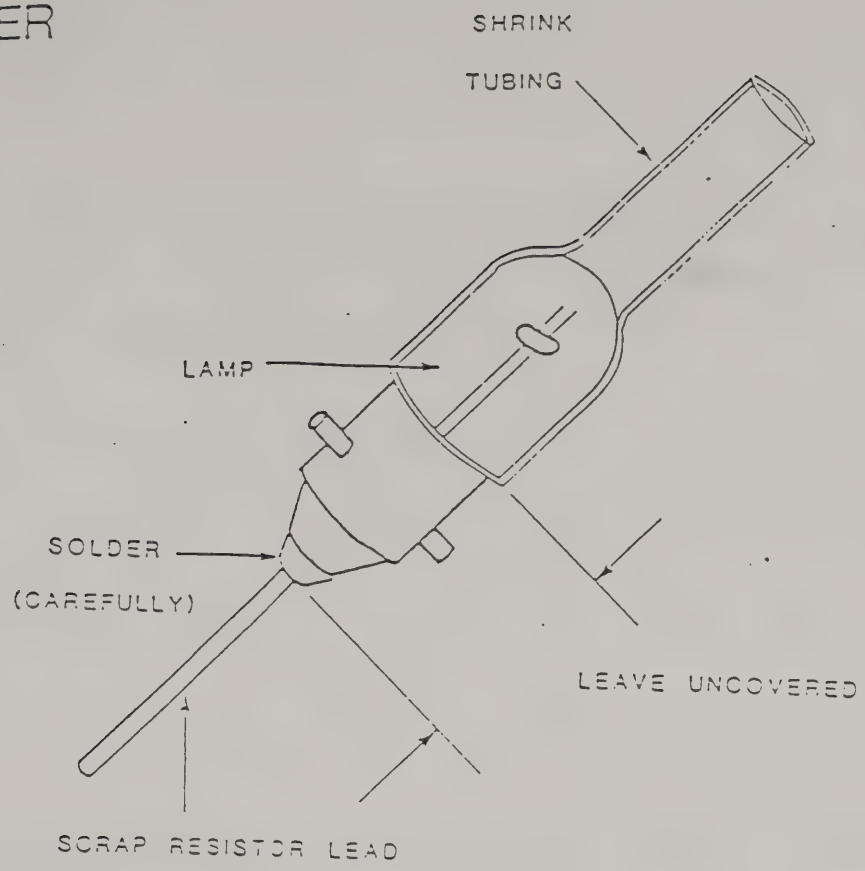


Set up a static-free work area for handling MOS components. Kit includes floor and table mat, wrist strap and two ground cords, or buy components separately. One megohm resistor in wrist strap protects worker.

Part Number	Description	Price
01-80386A82	Anti-Static Kit	$233.85
66-80387A95	Static Control Table Mat, 2" x 4"	71.45
66-80387A96	Static Control Floor Mat, 4" x 6"	192.75
66-80387A97	Floor Mat Ground Cord, 15'	13.65
66-80387A98	Table to Floor Mat Ground Cord, 5'	10.25
12-80385A59	Conductive Wrist Strap, 5' coil cord	24.25

TP1
FINAL
PA
TP6
(metal 3)
BRN
BLK
ORG
YEL
DRIVER
TP2
TP3
TP5
IPA INPUT
TP4
IPA
OUT

R.F. TESTER



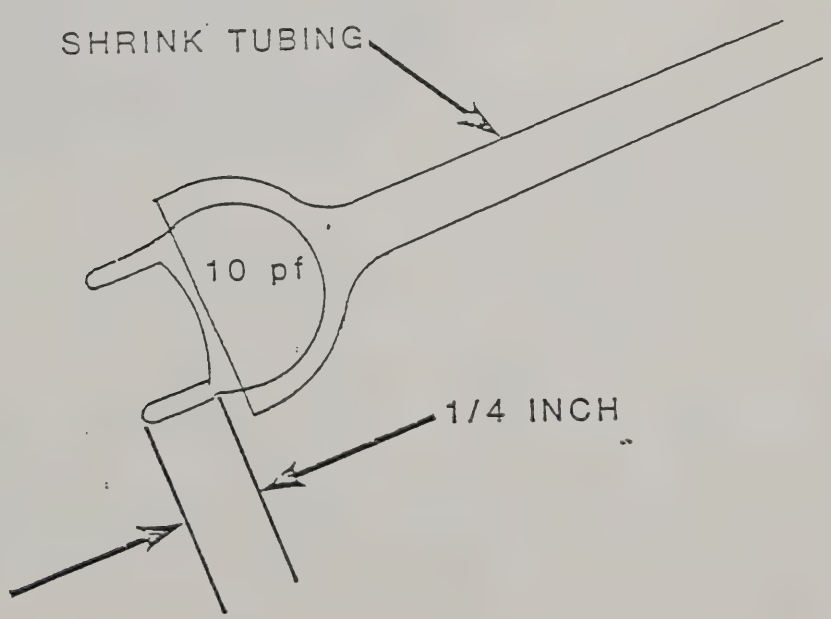
LAMP CHART

TYPE	VOLTS	AMPS	PART NUMBER
40	6 - 8	.15	65K14549
44	6 - 8	.25	65K10867
47	6 - 8	.15	65K11854
51	6 - 8	.20	65K4151
53	12 - 16	.10	65K857026
55	6 -8	.40	65K12355
57X	12 - 16	.23	65K535060
313	28	.04	65-82010C13
327	28	.04	65-83358H06
328	6	.20	65K861827
330	14	.80	65K861828
344	10	.015	65-82671G02
356	28	.17	65C82010C01
756	14	.08	65C82010C03
1445	18	.15	65C82010C02
1829	28	.07	65K810161

Trim the leads of a 10PF, NPO, disc ceramic capacitor to within 1/4 inch of the capacitor body. As shown, a length of shrinkable tubing over the capacitor body will make handling easier.

One at a time, bridge each transistor base-emitter junction with a 10PF capacitor, while the transmitter is keyed. If the transistor is good the power output of the stage will drop significantly (greater than 20%). If the transistor is bad, the stage power output will drop only slightly.

CAPACITOR BRIDGING METHOD OF TESTING P.A. TRANSISTORS



Surface Mounted Component Rework Station

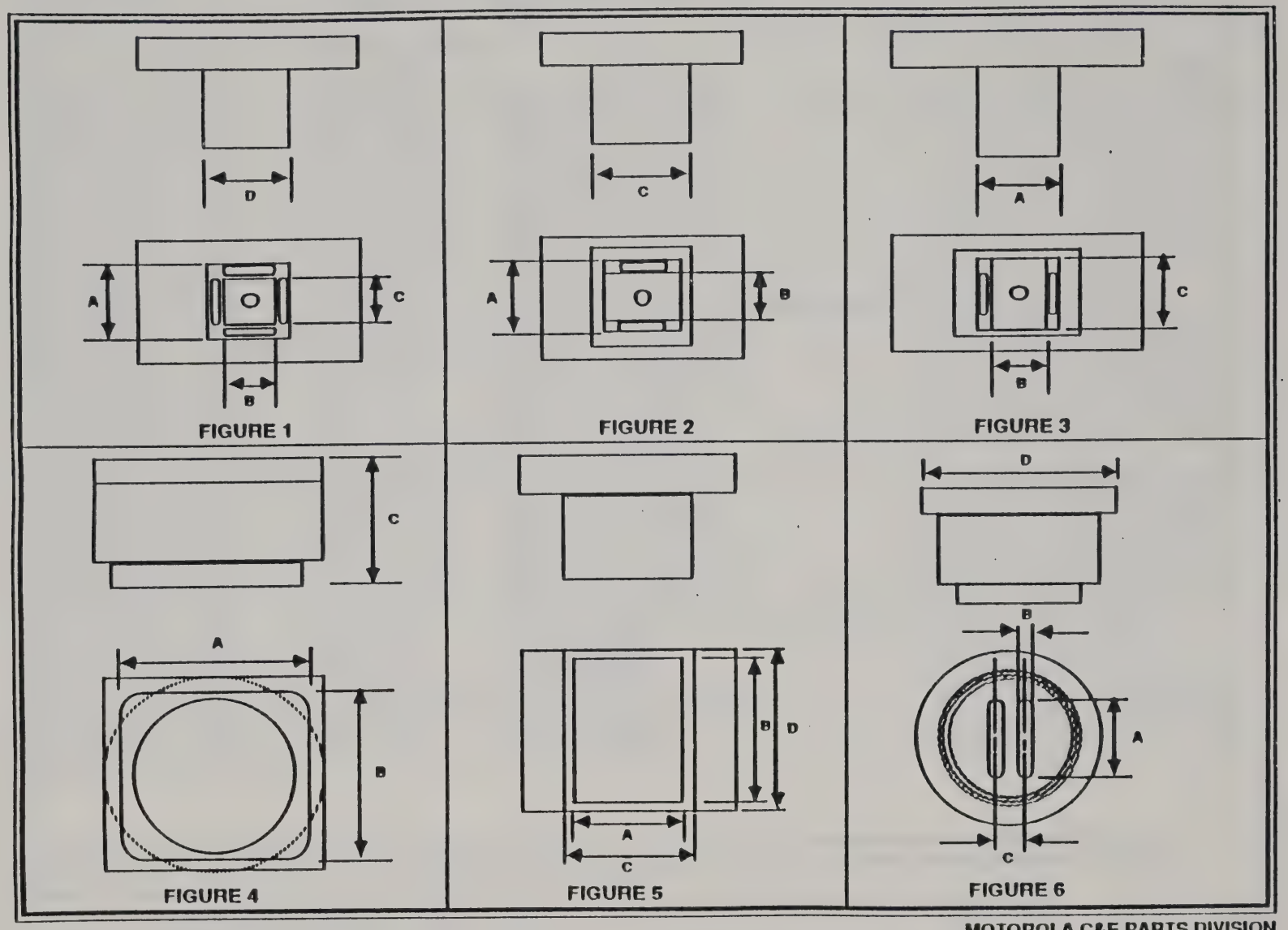
Fastest and easiest system available for removing and remounting surface mounted and leadless components. Rugged, heavy gauge aluminum construction. Slide-out tray provides X-Y-Z axis control and accepts PC boards up to 16" X 20". Separate temperature controls with precise top and bottom meter readouts. Hot air is directed on the leads, not the components. Interchangeable heat focus heads remove and remount the component. Comes complete with 2 small vacuum pick-up tips, 2 large vacuum pick-up tips, 3/8" lower air tube restrictor, and lower air tube shut off plug. Order heat focus heads separately.

Part Number	*Item*
RSX-4057A	Surface Mounted Component Rework Station, 120 VAC.
RSX-4058A	Surface Mounted Component Rework Station, 220 VAC.
Accessories:	
01-80320B54	Spare Parts Kit. Consists of 6 large vacuum tips, 6 small vacuum tips, High temperature grease, 1 Light bulb, 1 vacuum tube assembly,and 1 upper and 1 lower heater elements.
66-80322B65	Small vacuum pick-up tips 6 ea/pk
66-80322B66	Large vacuum pick-up tips 6ea/pk
66-80322B67	Anti-seize high temperature nickel grease
66-80322B68	Replacement high intensity light bulb
01-80320B86	Vacuum tube assembly w/wire stiffener
66-80322B69	Upper heater element w/connector
66-80371B72	Static dissipative flux dispenser

MOTOROLA
Communications Parts Division
1313 E. Algonquin Rd.
Schaumburg, Il. 60196

RSX-4057A

SURFACE MOUNT COMPONENT REWORK STATION



MOTOROLA C&E PARTS DIVISION
7/26/88

HEAT FOCUS HEAD DIAGRAMS

MOTOROLA NO.	UNGAR NO.	LOWER HEAT FOCUS HEADS DESCRIPTION	TYPICAL APPLICATION	FIG	DIMENSIONS A	B	C	D
66-80370B64	4780	lower heat focus	pin grid arrays, 1 inch square	4	1.125	1.125	1.375	
66-80370B47	4707	3/8" restrictor	restricts lower air, increases upper air					
66-80370B48	4707S	solid plug	shuts off lower air completely					
66-80370B49	4708	single slot	standard 7/8 pin SIP (use w/66-80334B54)		0.800	0.125		1.375
66-80370B50	4709	double slot	standard 14/16 pin DIP (use w/66-80370B61	6	0.800	0.063	0.300	1.375
66-80370B68	4792	double slot	28-pin DIP, .600 wide	6	1.400	0.062	0.600	
66-80370B69	4793	double slot	40-pin DIP, .600 wide	6	2.000	0.062	0.600	

MOTOROLA NO.	UNGAR NO.	UPPER HEAT FOCUS HEADS DESCRIPTION	TYPICAL APPLICATION	FIG	DIMENSIONS A	B	C	D
66-80370B51	4710	upper .450 quad	Jedec 28-pin ,.050 center	1	0.675	0.475	0.475	0.675
66-80370B52	4713	upper .950 quad	Jedec 68-pin ,.050 center	1	1.180	0.980	0.980	1.180
66-80370B53	4722	upper .490 quad	Jedec 28-pin , .050 center	1	0.710	0.510	0.510	0.710
66-80370B54	4723	upper .690 quad	Jedec 44-pin ,.050 center	1	0.910	0.710	0.710	0.910
66-80370B55	4724	upper .790 quad	Jedec 52-pin ,.050 center	1	1.010	0.810	0.810	1.010
66-80370B56	4725	upper .990 quad	Jedec 68-pin, .050 center	1	1.210	1.010	1.010	1.210
66-80370B57	4730	upper .237 quad	Jedec 16-pin ,.040 center	1	0.445	0.245	0.245	0.445
66-80370B58	4731	upper .333 quad	Jedec 20-pin ,.040 center	1	0.540	0.340	0.340	0.540
66-80370B59	4732	upper .353 quad	Jedec 24-pin, .040 center	1	0.560	0.360	0.360	0.560
66-80370B60	4753	upper SO 14	X,Y interchangeable	3	0.300	0.160	0.375	
66-80370B61	4771	upper SO 28	X,Y interchangeable (used w/66-80370B50)	2	0.440	0.300	0.725	
66-80370B62	4772	upper rect. quad .290 x .425	18 leads X,Y interchangeable	1	0.645	0.310	0.445	0.510
66-80370B63	4773	upper rect. quad .295 x .350	18 leads X,Y interchangeable	1	0.513	0.368	0.313	0.568
66-80370B65	4781	upper plain	companion to 66-80370B64	5	1.125	1.125	1.220	1.220
66-80370B66	4782	upper plain	very small, .180 square chips	1	0.220	0.180	0.180	0.220
66-80370B67	4788	upper plain	pin grid arrays, .50 inch	5	0.500	0.500	0.600	0.600
66-80370B97	4726	upper 1.190 quad	Jedec 84-pin ,.050 center	1	1.410	1.210	1.210	1.410
66-80370B98	4783	upper , 2 slots .300 x 1.000	18 and 20-pin DIPS					
66-80334B48	4718	upper.300 quad	Jedec16-pin , .050 center	1	0.518	0.318	0.318	0.518
66-80334B49	4721	upper .390 quad	Jedec 20-pin , .050 center	1	0.610	0.410	0.410	0.610
66-80334B50	4733	upper .423 quad	Jedec 32-pin , .040 center	1	0.630	0.430	0.430	0.630
66-80334B51	4734	upper .483 quad	Jedec 40-pin , .040 center	1	0.692	0.492	0.492	0.692
66-80334B52	4735	upper .563 quad	Jedec 48-pin , .040 center	1	0.772	0.572	0.572	0.772
66-80344B53	4741	upper gull wing rect. quad	80 leads , X,Y interchangeable	1	1.020	0.670	0.970	0.920
66-80334B54	4755	upper SO 16	X,Y interchangeable (use w/66-80370B49)	3	0.300	0.160	0.425	
66-80371B15	4767	upper SO 24	X,Y interchangable	2	0.440	0.300	0.625	
66-80371B23	4751	upper SO 8	X,Y interchangable	3	0.300	0.160	0.275	
66-80371B24	4757	upper SO 20(.33 width)	X,Y interchangable	2	0.550	0.375	0.570	
66-80371B74	4774	upper rect. quad .450 x .550	18 leads, X,Y interchangable	1	0.770	0.470	0.570	0.670
66-80371B75	4765	upper SO 20	X,Y interchangable	2	0.440	0.300	0.525	
66-80371B76	4758	upper SO 24 .330 body width	X,Y interchangable	2	0.550	0.375	0.670	

X,Y Interchangable-In the case of a rectangular component, the head may be installed 2 ways to accomodate either orientation on the PC board.
Heat Focus Head- An attachment for the RSX-4057(8)A which directs air around the perimeter of a surface mounted component (or SMD)
Quad - Surface mounted integrated circuit with connections on all four sides
Gull Wing (Inverted) - Refers to a SMD whose leads extend radially away from the body of the part rather than being formed down and under the body as in the "J" lead style

HEAT FOCUS HEADS TO RADIO MODEL CROSS REFERENCE

MODEL	PART #	DESCRIPTION / IC DESIGNATION
STX		
	66-80334B48	µ405, µ406, µ407, µ408, µ411
	66-80334B52	µ402, µ403, µ404
	66-80335B53	µ401
	66-80334B54	µ409, µ410, µ412
MTX-800		
	66-80334B48	µ401, µ405
	66-80334B51	µ402, µ403
	66-80334B52	µ404

MOBILES

SPECTRA

66-80371B23	µ3, µ45
66-80370B53	µ502, µ9730
66-80370B54	µ1, µ4,µ101, µ301, µ400, µ500, µ522, µ601, µ602, µ700
66-80370B55	µ520
66-80370B56	µ521

SYNTORX 9000/9000E

TRUNKING OPTION BOARD

66-80370B54	µ3
66-80370B55	µ1
66-80370B56	µ2
66-80371B23	µ10
66-80370B60	µ4

MDC SIGNALLING OPTION BOARD

66-80370B55	µ3
66-80371B23	µ2
66-80370B60	µ1, µ4, µ5, µ8
66-80371B24	µ6

MAXTRAC 100,300, MARATRAC

66-80370B52	µ803
66-80370B55	µ802
66-80371B23	µ601,µ603 etc (all SO 8's)

MAR 1 0 1987

SERVICE AIDS
SYNTOR X 9000E MOBILE RADIO

e following service aids are available through Motorola Communications & Electronics Parts facilitate servicing of the SYNTOR X 9000E Mobile Radios. Please contact your Area Parts Manager for price and delivery.

FIELD PROGRAMMING

Model No.	Description
	SYNTOR X 9000E RADIO SERVICE SOFTWARE The 9000E Radio Service software is designed to operate on the IBM PC, XT, or AT family of computers. It is suggested that one of these computers be used as the Programmer. IBM DOS 2.0 or higher, an RS232 Asynchronous Serial Communication Adapter, and RAM memory of 256K bytes minimum are necessary for programming.
01-80353A74	RADIO INTERFACE BOX (RIB) Voltage level shifter to enable communications between the radio and the computer's RS232 Serial Communication Adapter.
01-90357A44 for SX 9000E 01-80357A44 for SX 9000	IBM PC-XT COMPUTER INTERFACE CABLE Used to connect the computer's RS232 Asynchronous Serial Communications Adapter to the RIB (01-80353A74).
01-90357A64 for SX 9000E 01-80357A64 for SX 9000	IBM PC-AT COMPUTER INTERFACE CABLE Used to connect the computer's RS232 Asynchronous Serial Communications Adapter to the RIB (01-80353A74).
01-80353A75	RADIO INTERFACE ACCESSORY RIB CABLE - Used to connect the radio to the RIB box (01-80353A74).
RPX-4719A	SOFTWARE LICENSING PACKAGE Contains software licensing agreement, software ordering forms, and a list of available software. This kit must be ordered prior to software ordering.

FIELD PROGRAMMING

Model No.	Description
RVN-4010A for SX 9000E R-4008A for SX 9000	9000E RADIO SERVICE SOFTWARE ON 3 1/2 IN. DISK - Operates on computers with 3 1/2 in. floppy disk drives. The software and manuals provide the user with capability of changing the radio's frequency, options and mode names.
RVN-4009A for SX 9000E R-4007A for SX 9000	9000E RADIO SERVICE SOFTWARE ON 5 1/4 IN. DISK - Operates on computers with 5 1/4 in. floppy disk drives. The software and manuals provide the user with capability of changing the radio's frequency, options and mode names.

SERVICE MANUAL

Model No.	Description
6880101W62	9000E SERVICE MANUAL

SERVICE TOOLS

Model No.	Description
RSX-4057A	UNGAR HOT AIR BONDER Instantaneoous pinpoint soldering and repairing of hybrid circuits. Provides precision controlled spot heating for fast and easy repairs.

OPTION BOARD EXTENDERS

30-80052K07 Single Ribbon

30-80052K06 Double Ribbon

SERVICE AID LIST

SYNTOR X 9000 MOBILE RADIO

The following service aids are available through Motorola Communications & Electronics Parts to facilitate servicing of the SYNTOR X 9000 Mobile Radios. Please contact your Area Parts Manager for price and delivery.

FIELD PROGRAMMING

Model No.	Description
	SYNTOR X 9000 RADIO SERVICE HARDWARE The 9000 Radio Service software is designed to operate on the IBM PC, XT, or AT family of computers. It is suggested that one of these computers be used as the Programmer. IBM DOS 2.0 or higher, an RS232 Asynchronous Serial Communication Adapter, and RAM memory of 512K bytes minimum are necessary for programming. The software and manuals provide the user with the capability to change the radio's frequencies, mode names and other radio parameters.
01-80353A74	RADIO INTERFACE BOX (RIB) Voltage level shifter to enable communications between the radio and the computer's RS232 Serial Communication Adapter.
30-80369B71	IBM PC/XT COMPUTER INTERFACE CABLE This 25 pin cable is used to connect the computer's RS232 Asynchronous Serial Communications Adapter to the RIB (01-80353A74).
30-80369B72	IBM PC-AT COMPUTER INTERFACE CABLE This 9 pin cable is used to connect the computer's RS232 Asynchronous Serial Communications Adapter to the RIB (01-80353A74).
01-80353A75	RADIO INTERFACE ACCESSORY RIB CABLE - Used to connect the radio to the RIB box (01-80353A74).

FIELD PROGRAMMING

Model No.	Description
RPX-4719	SOFTWARE LICENSING PACKAGE Contains software licensing agreement, software ordering forms, and a list of available software. This kit must be ordered prior to ordering any software.
RVN-4008	9000 RADIO SERVICE SOFTWARE ON 3 1/2 IN. DISK - Operates on computers with 3 1/2 in. floppy disk drives.
RVN-4007	9000 RADIO SERVICE SOFTWARE ON 5 1/4 IN. DISK - Operates on computers with 5 1/4 in. floppy disk drives.

SERVICE TOOLS

Model No.	Description
RSX-4057	HOT AIR BONDER For instantaneous pinpoint soldering and repairing of hybrid circuits. Provides precision controlled spot heating for fast and easy repairs.
RSX-4044	ADJUSTABLE TORQUE DRIVER SET WITH BITS
01-80320B16	MAGNETIC SCREWDRIVER SET WITH BITS
	INSERTION AND EXTRACTION TOOLS
66-80163F01	Used to remove VIP connectors from the control head.
66-80371B14	Chip carrier extraction tool for MDC-1200. (Required to change software).
39-84257L01	VIP CONNECTOR-FEMALE CONTACT
09-80080L01	SHORTING PIN

SERVICE AID LIST

SYNTOR X 9000 MOBILE RADIO

The following service aids are available through Motorola Communications & Electronics Parts to facilitate servicing of the SYNTOR X 9000 Mobile Radios. Please contact your Area Parts Manager for price and delivery.

CONVENTIONAL ACCESSORIES

Model No.	Description
	SPARE ACCESSORIES GROUPS Provides all radio accessories including mounting plate. (Excludes antenna and manuals).
RPX-1026A	SPARE ACCESSORIES GROUP
RPX-1025A	SECURE CAPABLE SPARE ACCESSORIES GROUP
H1077A	SPARE CONTROL HEAD-32 MODE
H1110A	SPARE CONTROL HEAD-64 MODE
HKN4241A	RADIO POWER CABLE
HKN4256A	SECURE CAPABLE RADIO POWER CABLE

CONVENTIONAL SERVICE MANUALS

Model No.	Description
68-80100W94	9000 SERVICE MANUAL
68-80101W95	LOW BAND MANUAL
68-81060E05	VHF MANUAL
68-80100W45	UHF MANUAL
68-81044E40	800 MHz MANUAL

TRUNKING ACCESSORIES

Model No.	Description
RPX-1029A	TRUNKING SPARE ACCESSORIES GROUP Provides all trunked radio accessories including mounting plate. (Excludes antenna and manuals).
H1073A	SPARE CONTROL HEAD
H1071A	SMARTNET SPARE MEMORY MODUL Provides trunking code plug (Requires trunking control number).
H1072A	PRIVACY PLUS SPARE MEMORY MODULE Provides trunking code plug (Requires trunking control number).
HKN4241	RADIO POWER CABLE

TRUNKING SERVICE MANUALS

Model No.	Description
68-80100W89	9000 SERVICE MANUAL
68-81066E80	RADIO MANUAL

ANTI-SKID BRAKING PRECAUTIONS

1. GENERAL

The following recommended transmitter installation and test procedures are suggested for vehicles with electronic anti-skid braking systems.

2. INSTALLATION SUGGESTIONS

Locate the braking modulator box in the vehicle. The braking modulator box is located in the trunk in Chrysler Corporation cars and either in the trunk or under the dash in General Motors and Ford Corporation automobiles. A service manual may be helpful to aid in the location of the braking modulator box. Perform transmitter installation in accordance with the following recommended procedures:

- If the braking modulator box is mounted on the right side of the vehicle, mount the transmitter on the left side of the trunk to give it as much space as possible between the braking modulator box and the transmitter. If the braking modulator box is mounted on the left side, reverse the procedure.
- Use the shortest practical length of Motorola coaxial cable.
- The antenna should be mounted on the opposite side of the car trunk from the braking modulator box.
- Route all cables along the center or on the opposite side of the vehicle from the braking modulator box.
- *Do not* operate the transmitter while the vehicle is in motion with the trunk lid open.

3. TEST PROCEDURE

This test is divided to cover several different types of interference. Disturbance of the electronic anti-skid device can usually be detected in several different ways concerning the vehicle's braking system, i.e., by the lights, any irregular audible sounds, any change in the performance of the braking system itself, etc.

During Checks 1 through 6, however, none of the above conditions should be observed if the radio set is properly installed.

Check 1. With car stationary (gear selector in PARK) and the engine running at a fast idle, key (turn the carrier on and off) the transmitter with and without modulation with your foot off of the brake pedal.

Check 2. Repeat the preceding with your foot on the brake pedal.

Step 3. When making this test, while the car is stationary, allow at least 2 car lengths, and possibly even more, of clear area in front of the vehicle. With your foot on the brake with just enough pressure to keep the vehicle from moving, place the car in a forward gear with the engine at a fast idle, then key the transmitter with and without modulation.

WARNING

Disruption of the anti-skid braking system may cause the vehicle to move forward in addition to the lights and audible sounds mentioned above.

Check 4. Driving at a moderate speed (15-25 mph) with your foot off of the brake pedal, have an assistant key the transmitter with and without modulation.

Check 5. Repeat Step 4 with foot slightly on the brake pedal to turn on the brake lights.

Check 6. While making a moderate deceleration stop from 25-50 mph, have an assistant key the transmitter with and without modulation.

MOTOROLA INC.
Communications Division

service publications
1301 E Algonquin Road, Schaumburg, IL 60196

© Motorola, Inc. 1978
Printed in U.S.A.

68P81109E34-O
6/12/78- MG

LAB

WORKSHEETS

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

CONTROL HEAD OPERATION

The purpose of this lab is to acquaint you with some of the more common control head buttons; and how to properly operate them.

I. Description:

A. Alphanumeric Display: 11 characters (field programmable, common English names.)

B. Keypad: numbers 0 through 9, star and pound. Permits entry of a specific desired mode, phone number (if programmed for the phone option) etc. Also has dedicated buttons which will be explained later.

* Mode (Pre-programmed combination of operating parameters)

Trunking: System/Fleet/Subfleet combination and a time-out-timer value.

Conventional: transmit and receive frequency pair, an associated squelch code pair and time-out-timer value *

C. Standard Feature buttons: **(located above the alphanumeric display)** One to six buttons may be located in this area. (button and position is determined by field programming.)

D. Standard buttons: (located below the alphanumeric display)

(Ensure the following connections have been performed.)

1. Connect the radio cable to the "radio" portion of the back receptacle.

2. Connect the speaker wires to the speaker receptacle on the radio cable.

II. Button Operation:

A. ON/OFF: (located on the bottom plane right side)
1. **OFF:** slide to the left
2. **ON:** slide to the right

TURN THE RADIO ON: The radio should display the words "self check" then display the name of the preprogrammed "Home" mode.

B. **Rocker buttons:**

1. **MODE UP/DOWN:**

   a. **Normal Operation:** used to sequentially scroll up or down through a preprogrammed list of modes. The mode list will wrap around in either direction.

   b. **Configuration State:** used to scroll through preprogrammed option lists.

2. **VOL UP/DOWN:** used to sequentially increment through 0 to 15 volume levels. It will not wrap around.

C. **Push Buttons:**

1. **HOME: Operation**

   a. **Press:** radio goes to preprogrammed mode.

   b. **Press and Hold:** displays shows "MODE ___"
      (1) Use key pad to indicate desired mode
      (2) Use **SEL** button to select the desired mode.

      (This is convenient, for example, if the radio is on Mode 1 and the operator wants to select Mode 30. This is much faster than scrolling through each mode.)

2. **SQUELCH (SQL):**

   a. **Press:** display shows

      (1) "MONITOR ON": permits channel monitoring

      (2) "MONITOR OFF": disables the coded squelch (Taking the radio off hook accomplishes the same thing.)

   b. **Press and Hold until the beep sounds:** (Configuration state) display shows selected squelch level.

      (1) Possible squelch levels: 0 (unsquelched) to 4 (squelched)

      (2) Mode UP/DOWN and SEL: can be used to indicate and select desired squelch level

      (3) HOME: used to exit the configuration state (return to current mode) or wait 60 sec.

3. **DIMMER:** Adjust brightness of the display. (Four different levels)
(The default brightness is maximum brilliancy.)

   a. **Press Once:** less bright
   b. **Press Twice:** even less bright
   c. **Press Three times:** dark (for surveillance)
   d. **Press four times:** returns to full brightness

4. **SCAN:**

   a. **Press:** turns SCAN on or off

   b. **Press and Hold until the beep sounds:** (Configuration state) display shows SCAN list

      (1) Mode UP/DOWN: to desired mode name

         (a) **Add a mode: Press SEL**

            i) **once:** assigns mode to **Non-Priority**
            ii) **twice:** assigns mode to **Second Priority**
            iii) **three times:** assigns mode to **First Priority**

         (b) **Remove a mode:**

            i) select the mode you want to remove by using the keypad or Mode UP/DOWN button.

            ii) **Press delete (DEL)**

         (c) **Review the scan list:**

            i) **Press Recall (RCL) and hold:** the current scan list is displayed, and the mode priority is indicated.

         (d) **Press HOME to exit** the scan entry mode and scan will turn on.

   c. **Nuisance Mode Delete:** a Non-Priority mode may become too active. It can be temporarily deleted. **While the mode is actively being scanned press delete (DEL).**

5. **SCAN ENABLE:** (field programmable feature)

Permits the operator to decide in which modes have Operator Select Scan enabled or disabled. The radio would then have a combination of Mode Select Channel Scan and Operator Select Channel Scan.

6. **SCAN SQUELCH:** (field programmable feature)

SCAN: pressed: all PL/DPL channels in the scan list will become **carrier squelch.**

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

I. FUNCTIONAL TEST:

TRANSMITTER TEST

1. Set the monitor to the mode's TX frequency.

2. Set the monitor Function switch to MON.

3. Put the radio into test:
   a. While the radio is in the off condition, short JU500 on the Personality board. While maintaining this short turn the radio on. Remove the short after the radio has entered the test mode.

(There will be 4 test frequencies, F1-4, then 12 Factory Test frequencies, FT1-12. Usually F1-4 are the same as the control channel frequencies).

1. Rapidly keying and dekeying will rotate through all 16 test frequencies. (You should hear an audible beep indicating the test frequency number.

   a. Slowly keying and de-keying will rotate through the transmit modes of the test frequencies. Refer to Maint. & Troubleshooting Tab page 6 paragraph 2.6. **Select the Low Speed Mode** (example F1 LS) –

5. Key the transmitter and speak loudly into the microphone and check the following information on the monitor crt screen:

   a. Power out in watts 7.3

   b. Frequency error 840hz

   c. Deviation with 1KHz tone & LS (less than 5KHz) 5.1 khz

If Adjustments are necessary, use the procedures in the Maintenance and Troubleshooting Tab of the Service Manual.

Tx Carrier Deviation (Paragraph 2.3 Ref Osc Freq)

Compensation (Paragraph 2.4 - Figure 1 on page 2)

Deviation (Paragraph 2.2.4.3 Subaudible Connect Tone Plus Voice - Low Speed Mode)

Transmitter Power (Paragraph 2.6)

RECEIVER TEST

1. System Analyzer:
   a. Inject the Rx Frequency to the radio's antenna jack.
   b. Connect and O'scope between the SINAD BNC and the radio's SPKR HI & LOW (J1-22 & 37).
   c. Adjust the RF attenuator to -120dBm

2. Radio:
   a. Adjust the volume until a SINAD meter reading is obtained.

3. System Analyzer:
   a. Adjust the RF attenuator step and fine adjustment until -12Dbm is indicated by the meter.

4. Record the System Analyzer's RF output 1.29 uV (Ref:0.25uV)

mod accept 7.65

Trunked Syntor X 9000E
Mobile Radio

I. Power Distribution

A. Ensure the **power supply** is set for **13.8vdc** and the main red and black lead of the radio is connected to it. While the radio is off record the following points:

1. **Personality Board**

   a. J1-A 13.8v

   b. P300-6 13.8v

B. Ensure both the green and orange wires are hooked up to the power supply. **Turn on the radio** by sliding the on/off button left (9000 control head).

1. **Personality Board**

   a. J1-6 or 7 13.6v

2. **Common Circuits Board**

   a. Measure and record the normal/under and over voltage readings at the test points listed below. Perform the "Normal" checks first, then the "Under Vdc" and lastly the "Over Vdc".

9.

Test Point	Normal	Under Vdc Shutback	Over Vdc Shutback
J300 - 1	9.62v	____≈2.5vdc	____≈2.5vdc
J300 - 4	13.9v	____≈9vdc	____≈19vdc
J300 - 2	5v	____≈1.5vdc	____≈1.5vdc
U1000B - 5	6.18	____	____
U1000B - 4	7.07	____	____
U1000C - 1	7.07	____	____
U1000C - 3	3.19	____	____
U1000A - 8	7.66	____	____
U1000A - 10	1.85	____	____
Q1004 Base	13.4	____	____
Q1004 Collector	.165	____	____
U1000D - 14	5	____	____

After you have completed recording the "Over Vdc" then monitor J300-4, **decrease** the power supply voltage until it measures the Normal J300-4 reading.

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

I. PERSONALITY BOARD: DIGITAL SECTION

A. Measure and record the information at the points given below:

Ensure the radio is in the ON position.

MPU:

1. U500-1:VSS _____ .016v
2. U500-20 & 33: VCC _____ 5v
3. U500-2 & 3: clock 4.9152MHz _____ 4.9149 mhz
4. U500-64: E clock 1.2288MHz _____ 1.2288mhz

B. Data: Ensure the radio is in the OFF position. Place the test probe on the desired test point. Look at the o'scope's CRT then turn the radio on.

Watch Dog Timing Loop:

1. U500-6: $\overline{\text{Reset}}$ (held low to high) _____ low to high
2. HY500-2: Strobe(pulse at least every 20mSec) _____ 1.5msec

Test:

3. U500-21: $\overline{\text{Test}}$ _____ 5v

Associated IC's:

4. U504-1 & 10: Ground _____ .02v
5. U504-20: VCC _____ 4.86
6. U503-1 & 10: Ground _____ .019v
7. U503-20: VCC _____ 4.86v
8. U502-14: Ground _____ .02v
9. U502-28: VCC _____ 4.86v
10. U501-14: Ground _____ .02v
11. U501-1 & 28: VCC _____ 4.86v
12. U506-1 & 8: Ground _____ .019v
13. U506-16: VCC _____ 4.86v

Address/Data:

14. U500-34 to 41 — act
15. U500-43 to 58 — data lines noisy

EEPROM Write Protect: (Should not change in receive or transmit)

	Unkeyed	Keyed
16. Q513 Base	.66	.66
17. Q514 Base	4.2v	4.2
18. U502:23 or 27 $\overline{WE}$	4.93v	4.93v

Serial Bus between Personality Board, Control Head & Option Board(s)

	Unkeyed	Keyed
19. J1-4 or J301-19: Reset	.12v	.12v
20. U500-9: $\overline{\text{Busy In}}$	activity	activity
21. U500-13: Tx Data	activity	activity
22. U500-10: $\overline{\text{Busy Out}}$	activity	activity
23. U500-12 Rx Data	activity	activity
24. J1-17: Bus ±	activity	activity
25. J301-2: $\overline{\text{Tx Data}}$	"	"
26. J301-20: Rx Data	"	"
27. J1-5 & J301-1: Busy	"	"

Control Signals: (Transmit)

	Unkeyed	Keyed
Keyed 9.4vdc		
28. U500-28: K9.4vdc Enable	.02v	4.23v
29. Q512 Base	.024v	.74v
30. Q511 Base	9.2v	8.82v
31. P601/602-1 (0vdc or K9.4vdc)	.035v	9.5v
PA Enable	Unkeyed	Keyed
32. Q505 Base	activity	activity
33. Q504 Base	.2v	.7v
34. U500-27: PA Enable	0v	5v
35. J300-5: $\overline{\text{PA Enable}}$	(0vdc) 0v	(.5vdc) .2v

Select a mode with PL or DPL. Monitor the following points with the radio keyed.

36. U500-29 to 32 (PLB0 to 3) activity

Receive Control Signals:

37. U500-24: Detected PL (Inject Rx signal w/PL) sq wave
38. U500-22: Squelch Decision(change Sql lvl) high=unsq
39. U500-~~14~~ 16: Preamp Data (Digital Vol Attn) activity
40. U500-~~16~~ 14: Preamp Clock (Digital Vol Attn) activity
41. U302-3 (Vol 0=0vdc, Vol 15=~~5~~ 4vdc) 0-4v

Trunked Syntor X 9000E
Mobile Radio
LAB

I. FREQUENCY SYNTHESIZER

A. Ensure the **power** is **OFF**. Remove the RF shields which cover the synthesizer portion of the RF board.

B. Turn the **power ON**.

C. Look at the Out Of Lock light. It should blink a few times then go out.

D. **Power Distribution:**
Record the voltage at the following points.

1. J602-17: 5vdc — 5v
2. J602-18: 9.6vdc — 9.67v
3. U600-1: 9.6vdc — 9.66v
4. U600-4: Reg 8.6vdc — 8.82

E. **Data Distribution:**
While keying and dekeying look for activity change at the following points.

U602 (Loop Divider):

1. pin 11 — activity change
2. pin 12 — 4
3. pin 14 — 4
4. pin 13 — 4
5. pin 23 — 4
6. pin 24 — 4
7. pin 25 — 258.1mhz
8. pin 26 — activity change
9. pin 27 — activity change
10. pin 17 — low to high
11. pin 18 (U601 pin 5) — activity pulse
12. ~~pin 19~~ (6.25KHz feedback) — 6.25khz square wave
13. pin 20 — pulse

U601 (Prescaler): (ovdc or 5vdc)

1. pin 6:C1 — low to high
2. pin 7:$\overline{C0}$ — "

U603 (Phase Detector)

1. pin 4: Synth Sync — 100ms
2. pin 3: Low Band Width — low to high 4v
3. pin 8: TSW — low to high 9.6v
4. pin 9: RSW — high to low 9.8v
5. pin 5: Freq Change — pulse
6. pin 7: $\overline{Adapt}$ — -pulse 9.6v
7. pin 10: Adapt — +pulse 9.6v

F. **Loop Signals** (use waveform handout with this lab)

1. U601-1: ~~(Tx freq ÷ 2)~~ Rx - 53.9 ÷ 2 — 401.55 mhz
2. U601-3: (≈ VCO freq ÷ 3) — 267.6 mhz + harmonics
3. U602-25: (≈ VCO freq ÷ 3) — 267.6 x10 probe
4. U608-3: Ref Out: 14.4MHz — 0.5vpp
5. U602-2: Ref In: 14.4MHz — 0.45vpp
6. U602-9: TP62: Loop Out — 100µs 1.25vpp
7. U603-23: TP65: Loop In — 100µs 1.25vpp
8. U603-2: TP64: Ref In — 100µs 4vpp
9. U603-15: Phase Det Out — 4.3vdc
10. P650-2: Steering Line — 4.3vdc
11. P600: Buffered VCO output (Tx freq ÷ 2) — 401.55 @ -70dBm

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

I. RECEIVER: RF SIGNAL PATH: Three methods

A. Receiver Metering

1. Connect the meter cable (RTK-4043A) to the Radio Test Set (R1033A)

**** NOTE: The older Portable Test Set (S1056) can be used with the TEK-37A meter cable.****

2. Connect the **silver plug** of the meter cable to J250 on the RF Board.

3. Refer to the metering chart on the Receiver schematic for approximate normal indications.

Meter #	Switch Positions	Actual	Approximate Normal Indications
1.	Rev. & Ref A	25uA	**25uA**
2.	Rev. & Ref A	20uA 22uA	**15uA** Idle ↑**15uA** @ 20Dbq
3.	Rev. & Ref A	29uA 32uA	**30uA** w/ 2nd Inj ↑**2-3uA** w/o 2nd Inj
4.	Norm. & Ref A	5uA	**15uA**
5.	Rev. & Ref B	38uA	**20uA**

**** NOTE: Remove power from the test set by removing the test set cable. This increases battery life.****

B. Signal Tracing:

1. Adjust an RF signal generator for a 1mV signal and into the antenna connector.

2. Use a mV meter or spectrum analyzer to record the following:

Test Point	Actual Indication	Approximate Indication
20 (Y250/L217)	160mV	250mV
21 (U250-1)	12mV	60mV
22 (U250-5)	180mV	250mV
23 (Y253/C261)	520mV	750mV

24 (U251-1) 145mv 250mV

C. **Signal Injection:** The purpose of the section of the lab is to perform SINAD measurements starting from the Detector's input and working back to the antenna connector. The amount of signal injected should decrease as you progress to the antenna connector.

1. System Analyzer:

   a. RF output using a TEK-10 probe to the following test points.

   b. O'scope between the SINAD BNC and the radio's SPKR HI & LOW

   c. Adjust the RF attenuator for approximately -30Dbm.

2. Radio:

   a. Adjust the volume until a SINAD thermometer (and digital readout) is displayed on the System Analyzer's CRT.

3. System Analyzer:

   a. Adjust the RF attenuator step and fine adjustment until -12Dbm is indicated by the thermometer (and digital readout)

4. Record the following:

Test Point	**Actual Indication**	
24 (U251-1)	426uV	10.7
23 (Y253/C261)	294uV	
22 (U250-5)	661uV	
21 (U250-1)	8.9uV	
20 (Y250/L217)	5.4uV	
Q203 Gate #1	16.5uV	53.9
Q202 Drain	3.14uV	10.7
Q202 Source	28uV	1
Q201 Drain	2.4uV	53.9
Q201 Source	3.5uV	1

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

I. RECEIVE: ANALOG SIGNAL PATH

A. Squelch: With no signal injected measure the following test points for each squelch setting listed:

Squelch Level	U504-16 (MSB)	U504-15 (LSB)	HY301-1 Noise Vpp
4	.02v	.02v	5vpp
3	0v	5v	3.8vpp
2	5v	0v	0.5vpp
1	5v	5v	0.5vpp
0	0v	0v	5vpp

B. PL/DPL

1. Inject **Rx Frequency 1mV** to the radio's antenna jack.

2. **Modulation:**
   a. 1KHz at 3KHz deviation
   b. PL tone at 0.6KHz deviation

3. Measure the following test points:

Test Point	Type of Signal	Signal Level
P601-3 Detector's output	1KHz w/PL	2.1vpp 1k+pl
U300-19 PL Filter IN	1KHz w/PL	2.1vpp 1k+pl
U300-5 or 16 Filtered PL	Analog PL	0.4vpp pl
U300-4 Filtered PL (Limited)	Analog PL	0.1vpp pl
U300-3 Detected PL	Digital PL	10vpp pl

C. **Voice Audio**

1. Select audio load on the speaker.

2. Put the radio into test.

3. Inject **Rx Frequency 1mV** to the radio's antenna jack.

4. **Modulation:**
   a. 1KHz at 3KHz deviation
   b. PL tone at 0.6KHz deviation

5. Using the volume control increase the audio level out to approximately 11Vac (rms) across the speaker load.

**** NOTE: The audio load will get hot to the touch after a short period of time. BE CAREFUL! Do not leave the bench while the volume is turned up and the signal is injected or damage to the radio could result.**

6. Measure the following test points:

Test Point	**Type of Signal**	**Signal Level**
U300-20 RAS IN	1KHz w/PL	2vpp
U300-17 RAS OUT	1KHz	1.2vpp
U302-15 Preamp IN (Vol Cntrl)	1KHz	0.35vpp
U302-14 Preamp OUT (Vol Cntrl)	1KHz	0.63vpp
U400-4 Power Amp OUT	1KHz	6.2vpp
Q403B Collector Finals IN	1KHz	6vpp
Audio Load	1KHz	30vpp

TRUNKED SYNTOR-X 9000E
MOBILE RADIO
LAB

I. TRANSMITTER

A. Set Up:

1. Put the radio into test.

B. Control Signals:

Keyed 9.4vdc	Unkeyed	Keyed
1. U500-28: K9.4vdc En	_____	_____
2. Q512 Base	_____	_____
3. Q511 Base	_____	_____
4. P601/602-1 (0vdc or K9.4vdc)	_____	_____

PA Enable	Unkeyed	Keyed Adapt/Lock
5. Q505 Base	_____	_____/_____
6. Q504 Base	_____	_____/_____
7. U500-27: PA Enable	_____	_____/_____
8. J300-5: PA Enable	0vdc_____	.5vdc_____/_____

(use the Common Circuits Board schematic)

	Unkeyed	Keyed
9. J951-1: Control Voltage	-1.6V	1.13V

C. Adjustments:

Using the procedures in the Maintenance and Troubleshooting Tab of the Service Manual check the following adjustments:

1. **Tx Carrier Deviation** (Paragraph 2.3 Ref Osc Freq)
2. **Compensation** (Paragraph 2.4 - Figure 1 on page 2)
3. **Deviation** (Paragraph 2.2.4.3 Subaudible Connect Tone Plus Voice - Low Speed Mode)
4. **Transmitter Power** (Paragraph 2.6)

D. AUDIO

1. Select **PL** or **DPL Tx Mode.**
2. Key the transmitter and speak into the microphone.

The transmittter time out timer is pre-programmed. After time out you must dekey and key the transmitter.

3. Measure the following test points:

Test Point	Type of Signal	Signal Level
HY300-6 T Gate Hybrid IN	1KHz pre-emph	_____
U301D-12 Mic/Opt Limiter	1KHz limited	_____
U300-11 Spltr IN (Dev Pot Wiper)	1KHz	_____
U300-25 to 28 PLB0 to PLB3 (or DPL)	0v to 5v	_____
U300-15 Data/PL or DPL OUT	Analog PL/DPL	_____
P601-2 Ref Mod	Analog PL/DPL	_____
U300-8 (sum with spltr fltr audio)	Analog PL/DPL	_____
U300-13 Spltr Fltr OUT	1KHz mod w/ PL or DPL	_____
P602-20 VCO Mod	1KHz mod w/ PL or DPL	_____

E. RF

1. Using a voltmeter and RF Detector Probe make the following checks. **Key the radio only while actually making the checks.**

   a. IPA _____

   b. IPA Output _____

   c. Predriver _____

   d. Driver (35w only) _____

   e. Final PA _____

E. Refer to the Transmitter Tab page 1 paragraph 2.1 & 2.2 for the following test procedure.

**** Note how the probe and jumper is held will effect the meter readings! ****

Nominal measurements can be found on a table located on the troubleshooting table.

1. Control Voltage (measure J951-1 with a voltmeter) _____

2. MS1 (Foward voltage from the Directional Coupler) _____

3. MS2 (Reflected voltage from the Directional Coupler) _____

4. MS3 Transmit Injection (TP6 to TP5) _____

5. MS3 Q701 input (TP6 to TP4) _____

6. MS3 Q750 input (TP6 to TP3) _____

7. MS3 Q800 input (TP6 to TP2) _____

8. MS3 Q850 & 851 input (TP6 to TP1) (35w radio only) _____

9. Power out in watts _____

Trunked Control Option Lab

Remove the back panel of the radio. Position the radio so J1 to the front left side. Remove the cover located in the front left corner of the radio. Two boards should be piggy-backed. The top board is the memory board. The bottom one is the trunked control option board.

Measure and record the activity at the test points given below:

Power:

Test Point	Reference	Measurement
P301-14	UNSW5vdc	_____
P301-16	SW5vdc	_____
U1-26	SW5vdc	_____
P102-2	SW5vdc	_____
U201-28	SW5vdc	_____
U10-1	5vdc	_____
P301-8	9.6vdc	_____

Control Signals (between MPU's):

Test Point	Reference	Measurement	Remarks
P301-17	low	_____	Reset
P301-20	low	_____	Busy
P301-19	activity	_____	Rx serial data change modes)
U1-20	activity	_____	Rx serial data (change modes)
P301-18	activity	_____	Tx serial data (change modes)
U1-21	activity	_____	Tx serial data (change modes)
P301-9	high or low	_____	PA Enable
U1-31	low	_____	Reset
U1-17	low	_____	Reset
U1-30	activity	_____	Busy Out
U1-33	activity	_____	Busy In

Control Signals (between TCO and Memory boards):

Test Point	Reference	Measurement	Remarks
U1-7	7.9488MHz	_____	Xtal
U1-8	7.9488MHz	_____	Xtal
U1-19	high	_____	IRQ
U1-18	high	_____	IRQ
U1-27	activity	_____	High DTMF
U1-28	activity	_____	Low DTMF

U1-34	activity	_____	Data
U1-9	activity	_____	A0/D0
U1-10	activity	_____	A1/D1
U1-11	activity	_____	A2/D2
U1-12	activity	_____	A3/D3
U1-13	activity	_____	A4/D4
U1-14	activity	_____	A5/D5
U1-15	activity	_____	A6/D6
U1-16	activity	_____	A7/D7
U1-6	activity	_____	R/W

Anaolg Signals:

Test Point	Reference	Measurement	Remarks
P301-4	audio	_____	Det Audio
U3-32	audio	_____	Det Audio
U3-12	data	_____	Out
U3-13	data	_____	Feedback
U3-14	data	_____	Center Slicer
U3-4	data	_____	Data
P301-2	audio	_____	Rx Audio
P301-3	audio	_____	Tx Audio
U3-34	audio	_____	Tx Mod